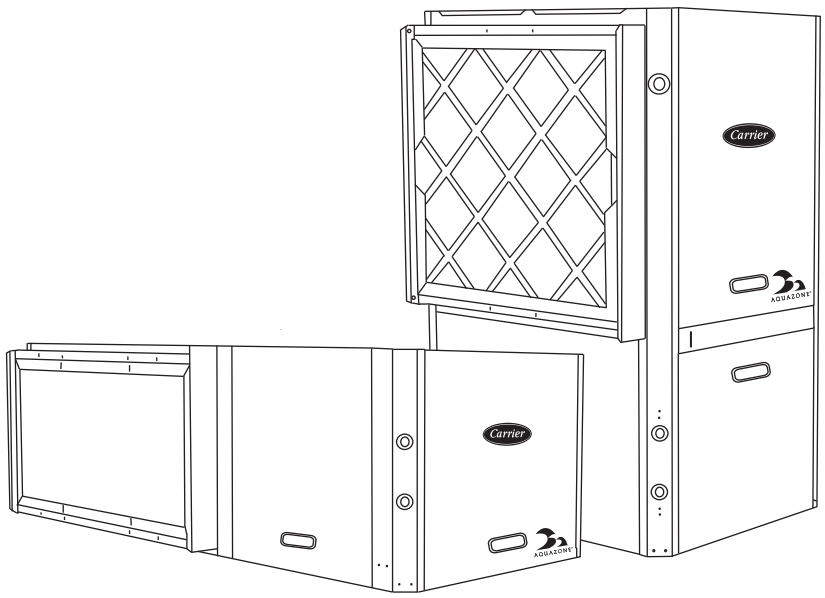
Carrier
United Technologies

Product Data

Aquazone™ 50PTH, PTV024-070 Two-Stage Water Source Heat Pumps with Puron® Refrigerant (R-410A)

2 to 6 Nominal Tons

AQUAZONE™



ASHRAE 90.1 COMPLIANT

Puron®

Single-package horizontally and vertically mounted water source heat pumps with electronic controls offer:

- Two-stage unloading scroll compressor
- Variable speed blower motor
- Exclusive double compressor isolation for ultra-quiet operation
- Available mute package for quieter operation
- Performance certified to AHRI/ISO 13256-1
- Flexible and reliable multiple protocol WSHP Open controller can use BACnet*, Modbus†, N2, and LonWorks** (with a separate card) protocols for integrating energy efficiency and precise unit control
- Hot gas reheat (HGR) available for dehumidification capability
- Optional tin-plated copper tubing and polymer coated aluminum fin air coil available
- Non-ozone depleting Puron refrigerant (R-410A)

Features/Benefits

Carrier's Aquazone two-stage water source heat pump (WSHP) with Puron refrigerant (R-410A) is a high quality, ultra-efficient solution for all boiler/tower and geothermal design applications.

Operating efficiency

Carrier WSHPs are designed for quality and high performance over a lifetime of operation. Two-stage WSHP models with Puron refrigerant offer cooling EERs (Energy Efficiency Ratios) to 37.0 and heating COPs (Coefficiency of Performance) to 6.5.

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Features/Benefits (cont)

All efficiencies stated are in accordance with standard conditions under ISO (International Organization for Standardization) Standard 13256-1:1998 and provide among the highest ratings in the industry, exceeding ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) 90.1 Energy Standards.

High quality construction and testing

All units are manufactured to meet extensive quality control protocol from start to finish through an automated control system, which provides continuous monitoring of each unit and performs quality control checks as equipment progresses through the production process. Standard construction features of the Aquazone™ units include:

Cabinet — Standard unit fabrication consists of heavy gage galvanized sheet metal cabinet construction designed for part standardization (i.e., minimal number of parts) and modular design.

All interior surfaces are lined with $1/2$ in. thick, $1\,1/2$ lb per cubic ft density, insulation for thermal insulation and acoustical attenuation. This insulation is non-combustible, non-hydroscopic and does not support fungal growth. Insulation meets NFPA90A and 90B for fire protection and is certified to meet the Greenguard Indoor Air Quality Standard for Low Emitting Products.

Compressor — Two-stage models with Puron® refrigerant (R-410A) offer a dual level vibration isolation system. Noise reduction is a critical consideration of the unit design. All units have a unique floating base. The compressor is mounted on a heavy steel plate which rests on a high density rubber pad on the base of the unit. In addition, compressors are mounted on rubber grommets. This double isolation is standard in all units, preventing vibration and noise transmission from the compressor to the unit structure, resulting in exceptionally quiet operation. The compressor has thermal overload protection and is located in an insulated compartment away from the airstream to minimize sound transmission.

Blower and motor assembly — Large blower wheels allow the unit to operate at lower speeds for quieter operation.

The standard constant-torque ECM (electronically commutated motor) blower motor can handle up to 1 in. wg external static pressure, making it a wise choice for high filtration applications. The 460-v constant torque ECM does not require a neutral wire.

Constant airflow ECMs are optional on units, allowing the user to select the correct speed to deliver the specified airflow and the design system static pressure.

Motors are mounted on the fan housing with rubber grommets to prevent noise and vibration transmission to the unit and airstream.

A 1-in. supply air duct-flange connection is standard, facilitating duct installation on the unit. Horizontal units are field convertible from right or left discharge to back discharge.

Refrigeration/water circuit — All units contain sealed Puron® refrigerant (R-410A) circuits including a high-efficiency Copeland UltraTech™ two-stage compressor designed for heat pump operation, a thermostatic expansion valve for refrigerant metering, an enhanced corrugated aluminum-lanced fin and rifled copper tube refrigerant-to-air heat exchanger, reversing valve, coaxial (tube-in-tube) refrigerant-to-water heat exchanger, and safety controls including a high-pressure switch, low-pressure switch, water coil low temperature sensor, and air coil low temperature sensor.

AHRI/ISO — Aquazone units have AHRI (Air-Conditioning, Heating, and Refrigeration Institute)/ISO, NRTL (Nationally Recognized Testing Lab), or ETL labels and are factory tested under normal operating conditions at nominal water flow rates. Quality assurance is provided via testing report cards shipped with each unit to indicate specific unit performance under cooling and heating modes of operation.

Quiet operation

Fan motor insulation and double isolated compressor are provided for sound isolation, cabinets are fully insulated to reduce noise transmission, low speed blowers are utilized for quiet operation through reduced outlet air velocities, and air-to-refrigerant coils are designed for lower airflow coil face velocities.

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Hanging brackets — All horizontal units come standard with hanging bracket kits for suspending the unit from field-supplied hanger rods. These kits include heavy duty steel brackets and rubber grommets for sound and vibration isolation from the building structure.

Puron® refrigerant (R-410A)

Puron refrigerant (R-410A) is a non-chlorine based enviromentally balanced, non-ozone depleting refrigerant. Puron refrigerant characteristics, compared to R-22, have:

- Binary and near azeotropic mixture of 50% R-32 and 50% R-125.
- Higher efficiencies (50 to 60% higher operating pressures).
- Virtually no glide. Unlike other alternative refrigerants, the two components in Puron refrigerant have virtually the same leak rates. Therefore, refrigerant can be added if necessary without recovering the charge.

Optional air coil protection

All units come standard with a copper coil aluminum fin air coil. These air coils employ lanced fin and rifled tubing for maximum heat transfer. Large face areas result in lower face velocity reducing sound while ensuring high latent heat removal for maximum dehumidification in the cooling mode.

Optional tin electro-plated copper tubing with high-tech polymer coated aluminum fins protect the air coil from all forms of corrosive elements in the airstream. Corrosion often results in refrigerant leaks and eventual failure of the air coil costing hundreds of dollars to replace. Studies have also shown that these air coil coatings improve moisture shedding and therefore improve a unit's moisture removal capability resulting in a more comfortable indoor environment. The 50PTH, PTV units assure both maximum air coil life and comfort.

Design flexibility

Airflow configurations for horizontal units are available in four patterns including left or right return, and left, right, or back discharge. Horizontal and downflow units are field convertible from left or right discharge to back discharge. Vertical units are available in three airflow patterns including top discharge with right or left return. Standard entering water temperature is between 50 and 100 F. Extended entering water temperature range between 25 F and 110 F offers maximum design flexibility for all applications. Water flow rates as low as 1.5 gpm per ton assist with selection from a range of various circulating pumps. Factory-installed options are offered to meet specific design requirements.

Safe, reliable operation

Standard safety features for the refrigerant circuit include high-pressure switch, low-pressure sensor to detect loss of refrigerant, and low air temperature sensor to safeguard against freezing. Equipment safety features include water loop temperature monitoring, voltage protection, water coil freeze protection, and standard electronic condensate overflow shutdown. All safety features are tested and run at the factory to assure proper operation of all components and safety switches.

All components are carefully designed and selected for endurance, durability, and carefree day-to-day operation.

The Aquazone™ unit is shipped to provide internal and external equipment protection. Shipping supports are placed under the blower housing and compressor feet. In addition, horizontal and vertical units are both mounted on oversized pallets with lag bolts for sturdiness and maximum protection during transit.

Ease of installation

The Aquazone unit is packaged for simple low cost handling, with minimal time required for installation. All units are pre-wired and factory charged with refrigerant. Horizontal units are provided with hanger isolation brackets. Vertical units are provided with an internally trapped condensate drain to reduce labor associated with installing an external trap for each unit. Water connections and condensate drains (FPT) are anchored securely to the unit cabinet.

Simple maintenance and serviceability

The Aquazone water source heat pump (WSHP) units are constructed to provide ease of maintenance. Units allow access to the compressor section from 2 sides and have large removable panels for easy access. Additional panels are provided to access the blower and control box sections.

The blower housing assembly can be serviced without disconnecting ductwork from the dedicated blower access panel. Blower units are provided with permanently lubricated bearings for worry-free performance. Blower inlet rings allow removal of the blower wheel without having to remove the housing or ductwork connections.

Electrical disconnection of the blower motor and control box is easily accomplished from quick disconnects on each component.

Easy removal of the control box from the unit provides access to all refrigeration components.

The refrigeration circuit is easily tested and serviced through the use of high and low pressure ports integral to the refrigeration circuit.

Maximum control flexibility

Aquazone water source heat pumps provide reliable control operation using a standard microprocessor board with flexible alternatives for many direct digital controls (DDC) applications including the open protocol systems.

The Aquazone™ standard unit solid-state control system, the Complete C, provides control of the unit compressor, reversing valve, fan, safety features, hot gas reheat, and troubleshooting fault indication features. The Complete C control system is a user friendly, low cost, advanced WSHP control board. Many features are field selectable to maximize flexibility in field installation. The overall features of this standard control system include:

75 va transformer — The transformer assists in accommodating accessory loads.

Anti-short cycle timer — Timer provides a minimum off time to prevent the unit from short cycling. The 5-minute timer energizes when the compressor is deenergized, resulting in a 5-minute delay before the unit can be restarted.

Random start relay — Random start relay provides a random delay in energizing each different WSHP unit. This option minimizes peak electrical demand during start-up from different operating modes or after building power outages.

High and low pressure refrigerant protection — This protection safeguards against unreliable unit operation and prevents refrigerant from leaking.

Condensate overflow sensor — The electronic sensor is mounted to the drain pan. When condensate pan liquid reaches an unacceptable level,

Features/Benefits (cont)

unit is automatically deactivated and placed in a lockout condition. Thirty continuous seconds of overflow is recognized as a fault by the sensor.

High and low voltage protection — Safety protection for excessive or low voltage conditions is included.

Automatic intelligent reset — Unit will automatically restart 5 minutes after shutdown if the fault has cleared. Should a fault occur 3 times sequentially, lockout will occur.

Accessory output — Twenty-four volt output is provided to cycle a motorized water valve or damper actuator with compressor in applications such as variable speed pumping arrangements.

Performance monitor (PM) — This feature monitors water temperatures to warn when the heat pump is operating inefficiently or beyond typical operating range. Field selectable switch initiates a warning code on the unit display.

Water coil freeze protection (selectable for water or antifreeze) — Field selectable switch for water and water/glycol solution systems initiates a fault when temperatures exceed the selected limit for 30 continuous seconds.

Air coil freeze protection (check filter operation) — Field selectable switch for assessing excessive filter pressure drop initiates a fault when temperatures exceed the selected limit for 30 continuous seconds.

Alarm relay setting — Selectable 24 v or pilot duty dry contact provides activation of a remote alarm.

Electric heat option — The output provided on the controller operates two stages of emergency electric heat.

Service Test mode with diagnostic LED (light-emitting diode) — The Test mode allows service personnel to check the operation of the WSHP and control system efficiently. Upon entering Test mode, time delays are sped up, and the Status LED will flash a code to indicate the last fault experienced for easy diagnosis. Based on the fault code flashed by the status LED, system diagnostics are assisted through the use of Carrier provided troubleshooting tables for easy reference to typical problems.

LED visual output — An LED panel indicates high pressure, low pressure, low voltage, high voltage, air/water freeze protection, condensate overflow, and control status.

* Sponsored by ASHRAE (American Society of Heating, Refrigerating, and Air-Conditioning Engineers).
† Registered trademark of Schneider Electric.
** Registered trademark of Echelon Corporation.

Model number nomenclature

50PTH,PTV PREMIUM EFFICIENCY

50PTV 024 J C C 3 A C A X

Aquazone™ Two-Stage Water Source Heat Pump with Puron® Refrigerant (R-410A)
50PTH – Horizontal Configuration
50PTV – Vertical Configuration

Unit Size – Nominal Tons
024 – 2
036 – 3
048 – 4
060 – 5
070 – 6

Airflow Configuration

Horizontal

Option	Return	Discharge	Blower Motor
B –	Right	End	Constant Torque ECM
E –	Left	Right (Straight)	Constant Torque ECM
N –	Right	Left (Straight)	Constant Airflow ECM
P –	Right	End	Constant Airflow ECM
S –	Left	End	Constant Torque ECM
W –	Left	End	Constant Airflow ECM
Y –	Left	Right (Straight)	Constant Airflow ECM
Z –	Right	Left (Straight)	Constant Torque ECM

Vertical

Option	Return	Discharge	Blower Motor
J –	Left	Top	Constant Airflow ECM
K –	Right	Top	Constant Airflow ECM
L –	Left	Top	Constant Torque ECM
R –	Right	Top	Constant Torque ECM

Control
C – Standard C Microprocessor Control Package
D – Deluxe D Microprocessor Control Package
W – WSHP Open with C Microprocessor Control

Refrigerant and Water Circuit Options

Option	Non-Coated Air Coil		Coated Air Coil	
	Cu	CuNi	Cu	CuNi
Standard	C	N	A	J
Hot Gas Reheat	E	P	D	F

Voltage
3 – 208/230-1-60
4 – 265-1-60
5 – 208/230-3-60
6 – 460-3-60
C – 208/230-1-60 with Disconnect
D – 265-1-60 with Disconnect
E – 208/230-3-60 with Disconnect
F – 460-3-60 with Disconnect

Revision Code
A – Current Revision

Valve Option
A – 2-Way Solenoid
C – None
D – Internal Pump

Operating Range/Sound Option/Insulation

Insulation	Extended Range	
	Std	Mute
Standard	A	J
1/2" Closed Cell Foam	D	F

Electic Heat	Factory-Installed Options		
	Std Filter	MERV8 Filter	MERV13 Filter
None	X	Y	Z
5 kW Electric Heat	A	B	W
10 kW Electric Heat	C	F	R
15 kW Electric Heat	D	G	S
20 kW Electric Heat	E	T	H

LEGEND
ECM — Electronically Commutated Motor

AHRI/ISO capacity ratings

50PTH, 50PTV FULL LOAD APPLICATIONS

UNIT SIZE	WATER LOOP HEAT PUMP				GROUND WATER HEAT PUMP				GROUND LOOP HEAT PUMP			
	COOLING 86 F		HEATING 68 F		COOLING 59 F		HEATING 50 F		COOLING 77 F		HEATING 32 F	
	CAPACITY Btuh	EER Btuh/W	CAPACITY Btuh	COP	CAPACITY Btuh	EER Btuh/W	CAPACITY Btuh	COP	CAPACITY Btuh	EER Btuh/W	CAPACITY Btuh	COP
024	25,500	17.4	29,200	5.6	29,000	26.5	23,500	4.9	26,600	19.9	18,000	4.1
036	39,000	19.0	42,800	5.6	43,300	28.0	35,900	5.1	40,800	22.3	28,400	4.3
048	49,200	16.6	56,100	5.3	55,300	25.3	46,300	4.7	51,300	19.3	36,900	4.0
060	63,800	17.0	73,300	5.2	70,200	24.4	60,300	4.6	65,100	18.9	48,000	3.9
070	71,600	16.3	84,000	5.1	78,700	23.1	70,000	4.5	73,700	18.5	55,300	3.8

LEGEND

AHRI — Air-Conditioning and Refrigeration Institute
COP — Coefficient of Performance
EER — Energy Efficiency Ratio
ISO — International Organization for Standardization

NOTES:
1. A brine-to-air heat pump using a brine solution circulating through a subsurface piping loop functioning as a heat source/heat sink.
2. The heat exchange loop may be placed in horizontal trenches or vertical bores, or submerged in a body of surface water.
3. The temperature of the brine is related to the climatic conditions and may vary from 20 F to 120 F.
4. Certified in accordance with the AHRI/ISO Standard 13256-1 Certification Program, with 15% antifreeze solution.
5. Table does not reflect fan or pump power connections for AHRI/ISO conditions.

50PTH, 50PTV PART LOAD APPLICATIONS

UNIT SIZE	WATER LOOP HEAT PUMP				GROUND WATER HEAT PUMP				GROUND LOOP HEAT PUMP			
	COOLING 86 F		HEATING 68 F		COOLING 59 F		HEATING 50 F		COOLING 68 F		HEATING 41 F	
	CAPACITY Btuh	EER Btuh/W	CAPACITY Btuh	COP	CAPACITY Btuh	EER Btuh/W	CAPACITY Btuh	COP	CAPACITY Btuh	EER Btuh/W	CAPACITY Btuh	COP
024	18,500	18.9	21,200	6.5	21,700	33.6	16,700	5.1	21,000	28.1	14,400	4.4
036	29,000	22.2	31,000	6.5	32,600	37.0	25,200	5.2	31,900	32.0	22,400	4.7
048	36,700	18.9	40,900	6.2	42,000	33.8	33,700	5.2	39,900	27.8	29,800	4.5
060	47,500	18.7	53,600	5.8	53,300	31.2	44,300	4.8	51,600	26.5	39,800	4.4
070	55,200	17.8	64,900	5.7	60,800	28.5	52,900	4.8	60,300	25.4	46,900	4.3

LEGEND

AHRI — Air-Conditioning and Refrigeration Institute
COP — Coefficient of Performance
EER — Energy Efficiency Ratio
ISO — International Organization for Standardization

NOTES:
1. A brine-to-air heat pump using a brine solution circulating through a subsurface piping loop functioning as a heat source/heat sink.
2. The heat exchange loop may be placed in horizontal trenches or vertical bores, or submerged in a body of surface water.
3. The temperature of the brine is related to the climatic conditions and may vary from 20 F to 120 F.
4. Certified in accordance with the AHRI/ISO Standard 13256-1 Certification Program, with 15% antifreeze solution.
5. Table does not reflect fan or pump power connections for AHRI/ISO conditions.

Physical data

PHYSICAL DATA — 50PTH, PTV 024-070 UNITS

UNIT 50PTH, PTV	024	036	048	060	070
COMPRESSOR	Scroll				
REFRIGERANT CHARGE 50PTV (oz)	58	98	88	110	114
REFRIGERATION CHARGE 50PTH ONLY (oz)	64	85	77	100	114
MAXIMUM WATER WORKING PRESSURE (psig/kPa)	450/3,100	450/3,100	450/3,100	450/3,100	450/3,100
ECM CONSTANT TORQUE - FAN MOTOR/BLOWER					
Fan Motor Type/Speeds	Constant Torque ECM / 5 speed				
Fan Motor (Hp)	0.33	0.75	0.75	1.00	1.00
Blower Wheel Size (D x W) (in.)	10 x 8	11 x 9	11 x 9	11 x 11	11 x 11
ECM CONST AIRFLOW - FAN MOTOR/BLOWER					
Fan Motor Type/Speeds	Constant Airflow ECM / 3 speed				
Fan Motor (Hp)	0.33	0.75	0.75	1.00	1.00
Blower Wheel Size (D x W) (in.)	10 x 8	11 x 9	11 x 9	11 x 11	11 x 11
WATER CONNECTION SIZE					
FPT	3/4	1	1	1	1
Coaxial Coil Volume (gal.)	0.33	1.18	0.62	1.07	1.12
VERTICAL CABINET					
Air Coil					
Dimensions (H x W) (in.)	24 x 20	32 x 26	32 x 26	38 x 26	38 x 26
Nominal Size Standard Filter - 2-in. MERV11 (L x H) (in.)	24 x 24 (1)	16 x 30 (2)	16 x 30 (2)	20 x 30 (2)	20 x 30 (2)
Weight (lb)					
Operating	250	360	340	410	440
Shipping	350	475	450	530	560
HORIZONTAL CABINET					
Air Coil					
Dimensions (H x W) (in.)	18 x 31.5	20 x 42	20 x 42	20 x 49	20 x 49
Nominal Size Standard Filter - 2-in. MERV11 (L x H) (in.)	18 x 18 (2)	20 x 24 (2)	20 x 24 (2)	18 x 20 (3)	18 x 20 (3)
Weight (lb)					
Operating	260	375	355	430	460
Shipping	360	495	470	550	580

LEGEND

ECM — Electronically Commutated Motor

Options and accessories

ITEM	FACTORY-INSTALLED OPTION	FIELD-INSTALLED ACCESSORY
Cupronickel Heat Exchanger	X	
Sound Attenuation Package	X	
1/2 in. Closed Cell Foam	X	
Extended Range Units	X	
Hot Gas Reheat	X	
Air Coil Protection	X	
Two-Way Solenoid Control Valve	X	
Internal Pump	X	
Electric Heater	X	
Constant Torque ECM	X	
Constant Airflow ECM	X	
Deluxe D Microprocessor Control Board	X	
WSHP Open Multi-Protocol Controller	X	
WSHP Open Equipment Touch™ Device		X
WSHP Open System Touch™ Device		X
WSHP Open ZS Sensor		X
Supply and Return Water Hose Kits		X
Electric Duct Heaters		X
Edge® Pro 7-Day Programmable Thermostat		X

Factory-installed options

Cupronickel heat exchangers are available for higher corrosion protection for applications such as open tower, geothermal, etc. Consult the water quality guidelines for proper application and selection of this option.

Sound attenuation package (mute package) is available for applications that require especially low noise levels. With this option, a compressor blanket is installed.

1/2-in. closed cell foam provides a 1/2-in. thick, closed cell foam insulation to help aid indoor air quality (IAQ) and to further attenuate low frequency noise from the compressor compartment. The closed-cell foam insulation option is available in all unit sizes.

Extended range units insulate the coaxial coil to prevent condensation, and therefore potential dripping problems, in applications where the entering water temperature is below the normal operating range (less than 50 F). Units are capable of operating at a range of 25 to 110 F.

Hot gas reheat (HGR) allows the unit to not only control space temperature, but also control humidity levels within the conditioned space. Both a thermostat and humidistat are needed for hot gas reheat operation. Once the thermostat reaches the set point temperature and if the humidity in the space is above set point, the factory-installed unit control board will energize the reheat valve allowing hot gas to flow from the compressor to the hot gas reheat coil downstream of the air coil. The cool, moist air leaving the air coil is now reheated to produce warmer, dryer air. The call for sensible cooling will always take precedence over the call for dehumidification, so if at any point the space temperature rises above set point, the hot gas reheat is turned off allowing for cooling only.

The hot gas reheat coil and reheat valve are factory installed and factory wired to the unit controller. For hot gas reheat performance data consult the WSHP Builder selection software.

Air coil protection provides optional tin electro-plated copper tubing with high-tech polymer coated aluminum fins will protect the air coil from all forms of corrosive elements in the airstream.

Two-way solenoid control valve is optional on all unit sizes and is mounted internal to the unit. The valve opens to allow full fluid flow to the coaxial coil when there is a call for heating or cooling, and shuts when no call for heating or cooling exists.

Internal pump is optional on all size units but cannot be used in conjunction with the two-way solenoid valve. The internal pump is an internally mounted ON/OFF circulating pump.

Electric heater is optional on all vertical units with top discharge and all horizontal units with end discharge configurations. Electric heaters are available in 5, 10, 15 and 20 kW at 208/230v in either single or three phase. Electric heaters are installed internal to the unit on the discharge of the fan.

Fan motor options

Constant torque ECMs are standard on all size units, and provide the efficiency and operability of an ECM at a lower cost than a constant airflow ECM. Constant torque ECMs provide 5 available motor speed settings and will maintain a constant motor torque as external static pressure in the system increases. As the system static pressure increases, reduction in fan airflow with a constant torque ECM is minor.

Constant airflow ECMs are optional on all size units and will maintain a constant unit airflow as the static pressure in the system increases. Constant airflow ECMs provide only 3 available speed settings.

Deluxe D microprocessor control board provides all of the options on the standard Complete C control board in addition to the following:

- Phase Monitor - Prevent motors from running at temperatures above approved ratings, and provides protection against phase loss, phase reversal, and phase unbalance.
- Boilerless Control - For use when the desired means of heating will be via an electric heater, and no boiler is installed in a water loop system.
- Energy Management Switch - Enables a 24 vac external signal to control the operation of the WSHP.
- Pump-Valve Relay - Provides a signal between an isolation valve and a secondary pump.

COMPLETE C AND DELUXE D BOARD CAPABILITIES

CAPABILITY	COMPLETE C BOARD	DELUXE D BOARD
High and low refrigerant pressure switches	X	X
Fluid temperature (freeze) protection	X	X
Condensate overflow protection sensor	X	X
Air temperature (freeze) protection	X	X
Anti-short cycle timer	X	X
Random start relay	X	X
Low pressure bypass timer	X	X
Surge protection	X	X
Intelligent reset	X	X
Lockout reset	X	X
Malfunction (alarm) output	X	X
Test service mode with LED fault Indication	X	X
Dehumidification control via hot gas reheat	X	X
Factory-installed electic heater	X	X
Factory-installed internal pump	X	X
Two-stage compressor control	X	X
Transformer	75 va	75 va
WSHP Open compatibility*	X	X
Phase monitor (3-phase units only)		X
Boilerless control		X
External LED fault indication		X
Energy management switch		X
Pump-valve relay		X

* WSHP Open installed with Complete C board.

WSHP Open multi-protocol controller — Carrier's WSHP Open controller is an integrated component of a Carrier water source heat pump. The WSHP Open controller continuously monitors and regulates water source heat pump operation with reliability and precision. This advanced controller features a sophisticated, factory-engineered control program that provides optimum performance and energy efficiency.

The WSHP Open controller is factory installed and programmed to control all factory-installed standard options including hot gas reheat and waterside economizer as well as provide boilerless electric heat control and demand controlled ventilation.

The WSHP Open controller is programmed to communicate amongst different protocols including BACnet, N2, Modus and LonWorks. While the controller is programmed to operate on Carrier's i-Vu® building automation system (BAS), the WSHP Open can easily be integrated into a third party BAS.

NOTE: A separate LON integration card is required for LonWorks.

Three-speed fan control to provide the most efficient WSHP operation. All WSHP Open controllers come programmed from the factory with three-speed fan control, with user selectable low, medium and high fan speeds. Using the space temperature input, the WSHP Open controller will automatically operate the fan at the lowest of the 3-speeds to maintain space temperature while providing increased latent heat removal, reduced sound and the lowest fan energy consumption.

NOTE: Three-speed fan control not available with constant airflow ECM fan motors. Three-speed fan control available only with constant torque ECM and PSC fan motors.

Intuitive fault detection to allow prolonged operation of the WSHP. The pre-programmed WSHP Open controller logic monitors and pre-emptively shuts down a WSHP as an alarming condition approaches instead of causing a hard lock out of the WSHP. This way, the WSHP can automatically restart if the fault condition clears within a set amount of time and a local reset of the WSHP is not required.

Learning Adaptive Optimal Start to transition the WSHP from unoccupied setpoints to occupied set points in the most efficient means possible. Over time, the WSHP will learn and determine the best adjustment rates of the setpoints to provide the most efficient means of shifting the WSHP to an occupied mode.

Field-installed accessories

WSHP Open Equipment Touch™ and System Touch™ touchscreen devices have a color LCD display that allows easy connection to the controllers to view or change the controller's property values including set points, schedule equipment, view trends and alarms and more. The Equipment Touch device provides easy connection to one controller while the System Touch device can access up to 60 controllers when wired together as a network. For more details about the Equipment Touch and System Touch devices, see either the Equipment Touch or System Touch Installation and Setup Guide.

Options and accessories (cont)

WSHP Open - ZS sensors

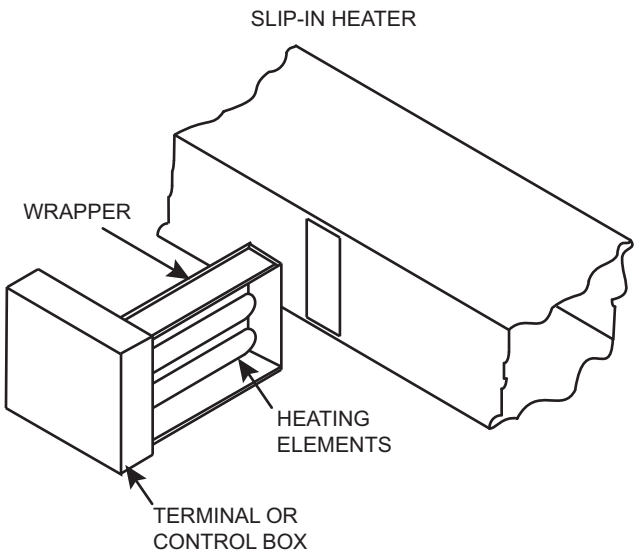
Carrier's ZS sensors are the preferred method of monitoring space temperature, humidity and CO_2 levels when using the WSHP Open controller.

NOTE: A ZS sensor is required for space temperature with all WSHP Open controllers. Only a ZS sensor can provide the necessary space temperature input for the WSHP Open controller.

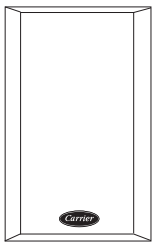
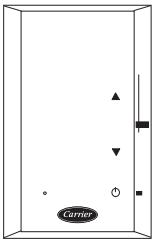
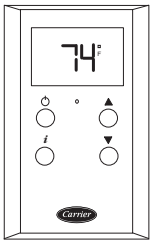
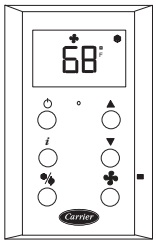
Supply and return water hose kits are available as accessories. Hose kits are recommended for connection between the unit and the water loop piping. Hose kits are 24 inches in length, flexible stainless steel and have options for manual isolation valves with and without autoflow regulators and Y-strainers.

Electric duct heaters are available ranging from 5 to 20 kW of electric heat in all available WSHP voltages. These slip-in type heaters provide an extra means of auxiliary heat or reheat control.

ELECTRIC DUCT HEATERS



ZS SENSOR FEATURES

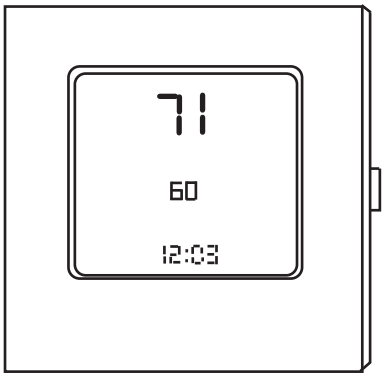
FEATURES	 ZS STANDARD	 ZS PLUS	 ZS PRO	 ZS PRO-F
Temp, CO_2, Humidity	X	X	X	X
Neutral Color	X	X	X	X
Addressable/Supports Daisy-Chaining	X	X	X	X
Hidden Communication Port	X	X	X	X
Mounts on a Standard 2-in. X 4-in. Electrical Box	X	X	X	X
Occupancy Status Indicator		X	X	X
Push-Button Occupancy Override		X	X	X
Set Point Adjust		X	X	X
Large, Easy-to-Read LCD			X	X
Alarm Indicator			X	X
Fan Speed Control			X	X
Cooling/Heating/Fan Only - Mode Control				X
F to C Conversion Button				X

ZS SENSOR OPTIONS

OPTIONS	ZS STANDARD	ZS PLUS	ZS PRO	ZS PRO-F
	PART NUMBER			
Temperature Only	ZS-CAR	ZSPL-CAR	ZSP-CAR	ZSPF-CAR
Temperature with CO_2	ZS-C-CAR	ZSPL-C-CAR	ZSP-C-CAR	ZSPF-C-CAR
Temperature with Humidity	ZS-H-CAR	ZSPL-H-CAR	ZSP-H-CAR	ZSPF-H-CAR
Temperature with Humidity and CO_2	ZS-HC-CAR	ZSPL-HC-CAR	ZSP-HC-CAR	ZSPF-HC-CAR

Edge® Pro 7-day programmable thermostat is available for connecting a unit directly to a wall mounted thermostat. The Edge Pro thermostat offers 2-stage heat, 2-stage cool, remote sensor capability, pre-occupancy purge, soft start, manual/auto changeover, 4 settings per day, 24 vac, backlit LCD, keypad lockout, no batteries required, 5-minute compressor protection, never lost memory, 3 security levels, and temperature display in degrees F or C.

EDGE PRO THERMOSTAT

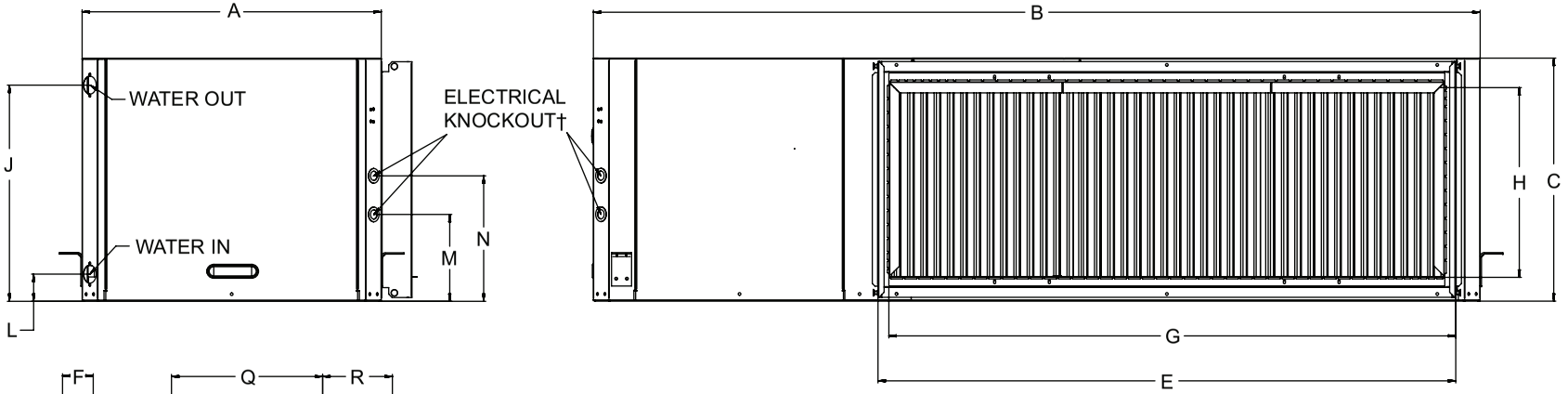


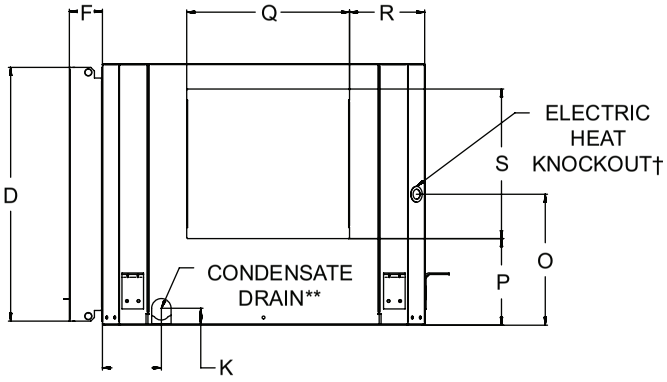
50PTH024-070 UNITS SUPPLY AIR CONFIGURATION - END DISCHARGE

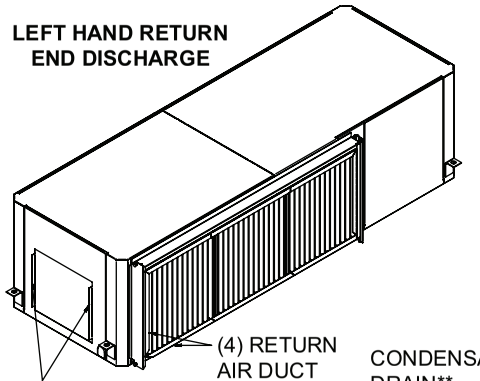
50PTH UNIT	A	B	C	D	E	F	G	H	J	K	K'	L	M	N	O	P (RH)	P' (LH)	Q	R (RH)	R' (LH)	S	WATER CONNECTIONS	FILTER SIZE
	WIDTH	DEPTH*	HEIGHT	FILTER RACK			RETURN AIR DUCT		WATER OUT	DRAIN PORT		WATER IN	ELECTRICAL KNOCKOUT		HEATER KNOCKOUT	SUPPLY AIR DUCT OPENING							
				HEIGHT	WIDTH	DEPTH	WIDTH	HEIGHT															
024	25.1	64.1	19.7	19.5	36.1	3.4	34.0	16.2	17.2	1.3	5.1	2.5	8.1	11.7	9.9	6.5	2.0	10.0	7.5	7.5	10.8	3/4" FPT	18 X 18 X 1 (2)
036	28.0	76.0	22.7	22.1	48.1	3.4	46.0	18.2	20.2	1.3	5.1	2.5	8.1	11.7	11.4	7.5	2.0	11.7	9.0	7.7	13.0	1" FPT	20 X 24 X 1 (2)
048	28.0	76.0	22.7	22.1	48.1	3.4	46.0	18.2	20.2	1.3	5.1	2.5	8.1	11.7	11.4	7.5	2.0	11.7	9.0	7.7	13.0	1" FPT	20 X 24 X 1 (2)
060	28.0	83.0	22.7	22.1	54.1	3.4	52.0	18.3	20.2	1.3	5.1	2.5	8.1	11.7	11.4	7.5	2.0	14.2	6.5	6.5	13.0	1" FPT	18 X 20 X 1 (3)
070	28.0	83.0	22.7	22.1	54.1	3.4	52.0	18.3	20.2	1.3	5.1	2.5	8.1	11.7	11.4	7.5	2.0	14.2	6.5	6.5	13.0	1" FPT	18 X 20 X 1 (3)

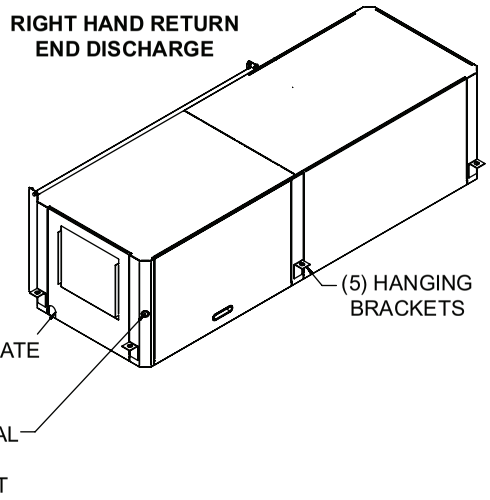
* When WSHP Open controller is installed increase depth by 1.25 inch.
† Electric heat is an optional feature.
** Condensate drain connection is 3/4-in. FPT.

NOTES:
1. All dimensions are shown within ± 0.125 inch.
2. Return air and supply air duct flanges shipped unfolded.
3. Dimensions are shown in inches.
4. Specifications subject to change without notice.
5. Add 0.5 in. to the height for base support rails (not shown).
6. Units can be field converted between end discharge and straight through supply air configurations with kits.
7. Hand configuration determined when facing panel with water connections.









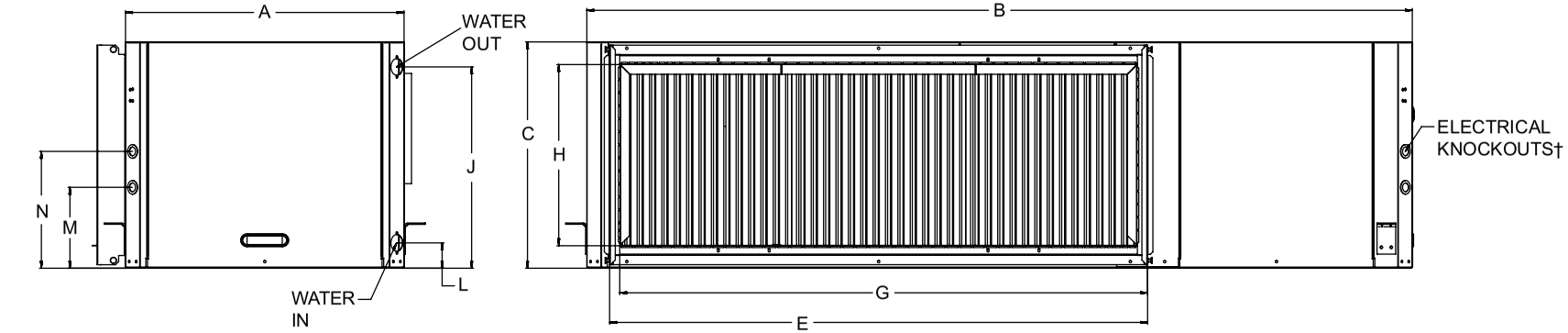
Service Access to:

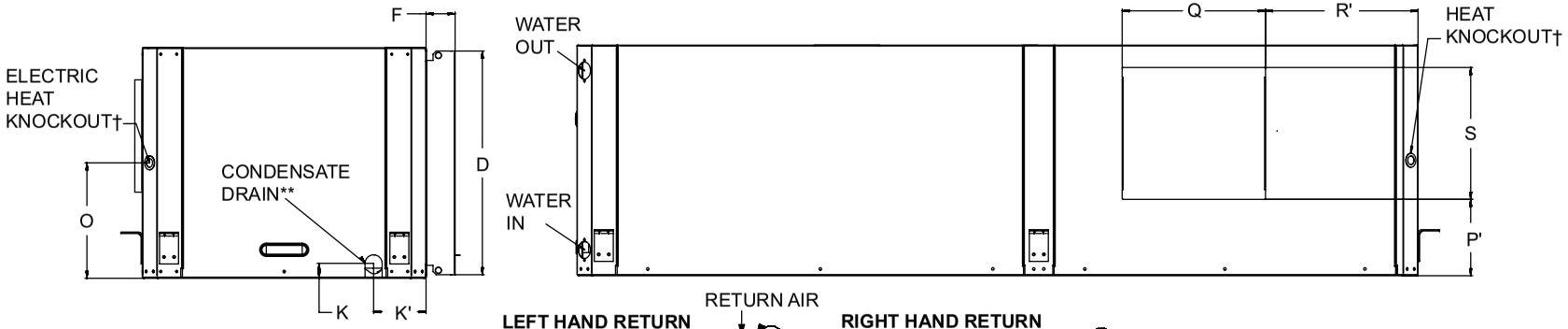
COMPRESSOR CONTROLS	BLOWER AND MOTOR	REFRIGERATION COMPONENTS
36 in.	18 in.	36 in.

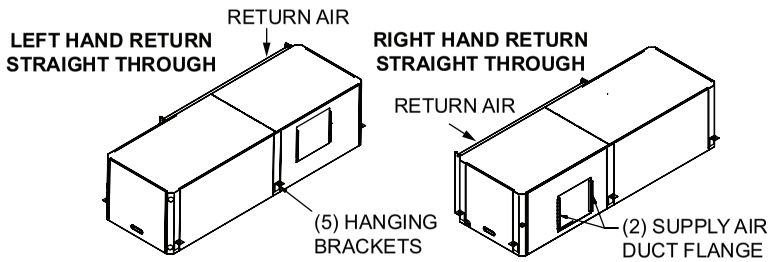
50PTH024-070 UNITS SUPPLY AIR CONFIGURATION - STRAIGHT THROUGH

50PTH UNIT	A	B	C	D	E	F	G	H	J	K	K'	L	M	N	O	P (RH)	P' (LH)	Q	R (RH)	R' (LH)	S	WATER CONNECTIONS	FILTER SIZE
	WIDTH	DEPTH *	HEIGHT	FILTER RACK			RETURN AIR DUCT		WATER OUT	DRAIN PORT		WATER IN	ELECTRICAL KNOCKOUT		HEATER KNOCKOUT	SUPPLY AIR DUCT OPENING							
				HEIGHT	WIDTH	DEPTH	WIDTH	HEIGHT															
024	25.1	64.1	19.7	19.5	36.1	3.4	34.0	16.2	17.2	1.3	5.1	2.5	8.1	11.7	9.9	2.0	6.5	10.0	11.8	11.8	10.8	3/4" FPT	18 X 18 X 1 (2)
036	28.0	76.0	22.7	22.1	48.1	3.4	46.0	18.2	20.2	1.3	5.1	2.5	8.1	11.7	11.4	2.0	7.5	11.7	12.9	12.9	13.0	1" FPT	20 X 24 X 1 (2)
048	28.0	76.0	22.7	22.1	48.1	3.4	46.0	18.2	20.2	1.3	5.1	2.5	8.1	11.7	11.4	2.0	7.5	11.7	12.9	12.9	13.0	1" FPT	20 X 24 X 1 (2)
060	28.0	83.0	22.7	22.1	54.1	3.4	52.0	18.3	20.2	1.3	5.1	2.5	8.1	11.7	11.4	2.0	7.5	14.2	15.1	15.1	13.0	1" FPT	18 X 20 X 1 (3)
070	28.0	83.0	22.7	22.1	54.1	3.4	52.0	18.3	20.2	1.3	5.1	2.5	8.1	11.7	11.4	2.0	7.5	14.2	15.1	15.1	13.0	1" FPT	18 X 20 X 1 (3)

* When WSHP Open controller is installed increase depth by 1.25 inch.
† Electric heat is an optional feature.
** Condensate drain connection is 3/4-in. FPT.
NOTES:
1. All dimensions are shown within ± 0.125 inch.
2. Return air and supply air duct flanges shipped unfolded.
3. Dimensions are shown in inches.
4. Specifications subject to change without notice.
5. Add 0.5 in. to the height for base support rails (not shown).
6. Units can be field converted between end discharge and straight through supply air configurations with kits.
7. Hand configuration determined when facing panel with water connections.







Service Access to:

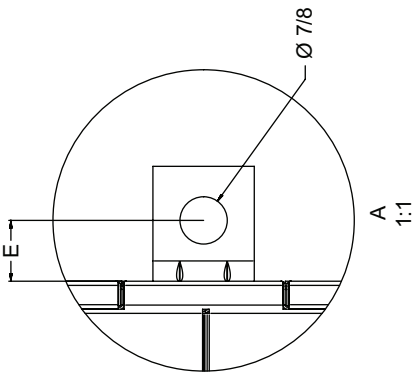
COMPRESSOR CONTROLS	BLOWER AND MOTOR	REFRIGERATION COMPONENTS
36 in.	18 in.	36 in.

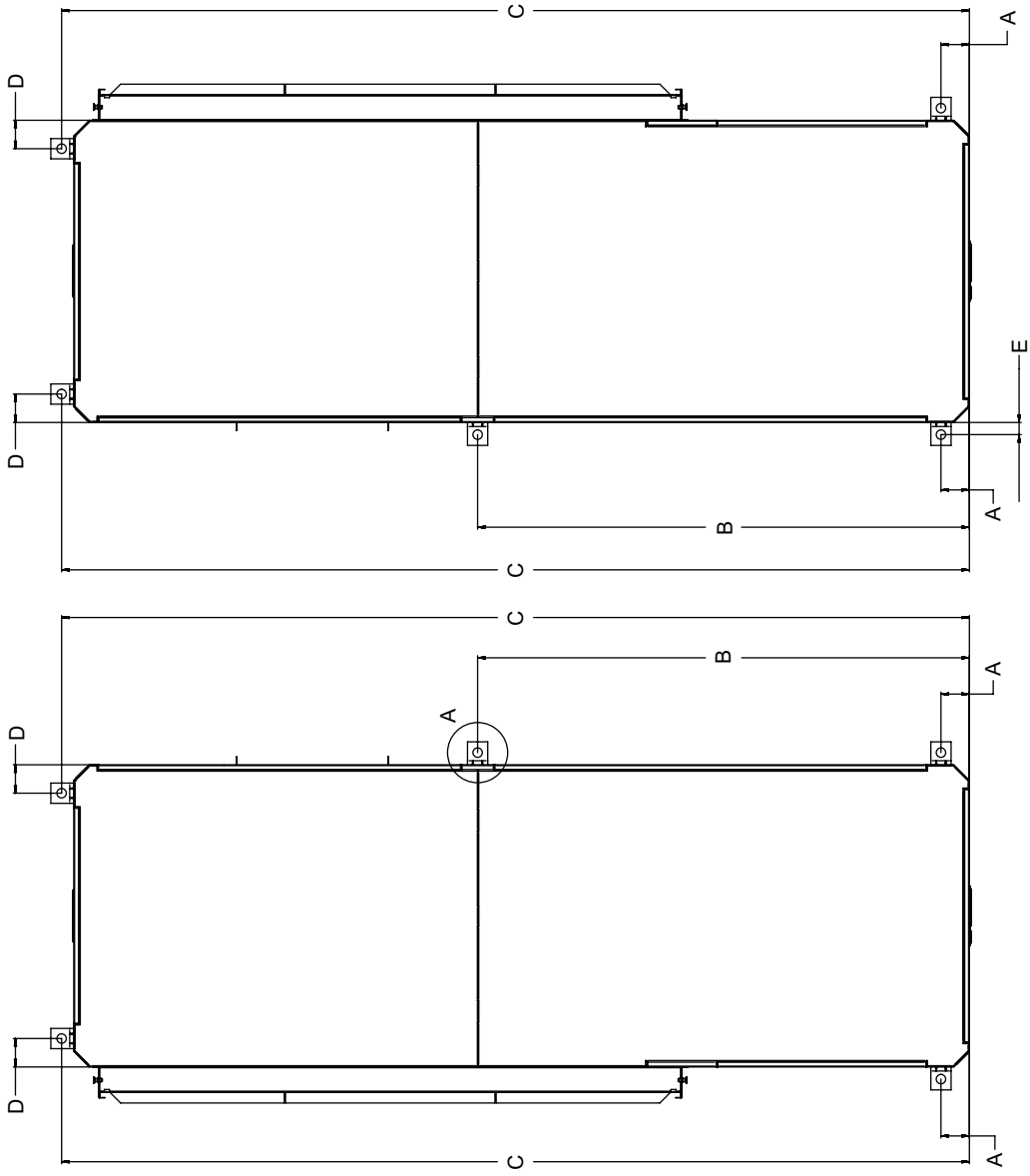
Dimensions (cont)

50PTH024-070 UNITS HANGING BRACKET SPECIFICATIONS

50PTH UNIT	A	B	C	D	E
024	2.634	32.817	65.225	2.634	1.125
036	2.634	33.972	77.125	2.634	1.125
048	2.634	33.972	77.125	2.634	1.125
060	2.634	45.573	84.125	2.634	1.125
070	2.634	45.573	84.125	2.634	1.125

NOTES:
1. All dimensions are within ± 0.125 inch.
2. All dimensions are shown in inches.
3. Specifications subject to change without notice.
4. Dimension "E" is typical for all models, configurations and bracket positions.





RIGHT HAND RETURN - TOP VIEW

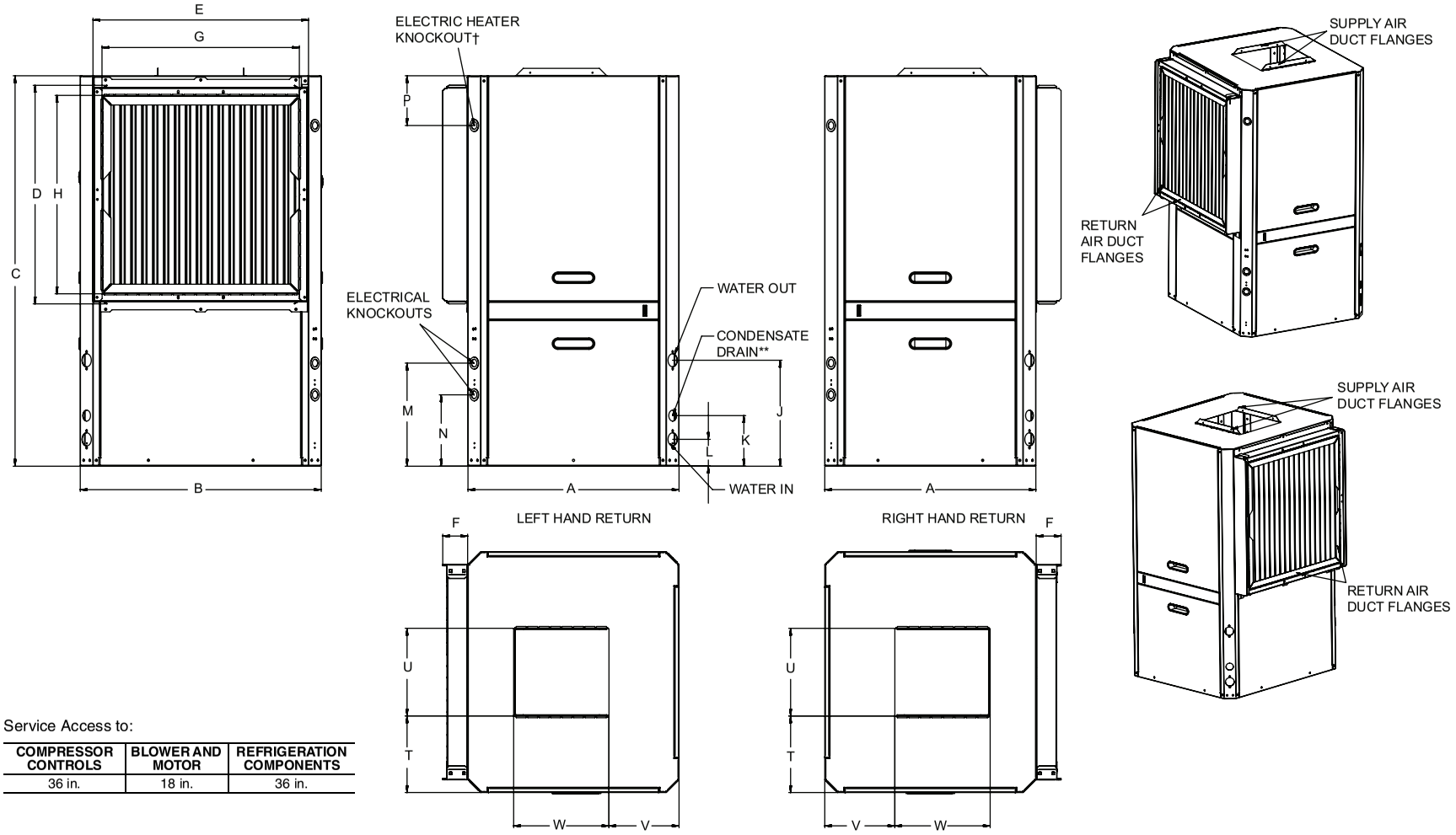
LEFT HAND RETURN - TOP VIEW

50PTV024-070 UNITS

50PTV UNIT	A	B	C	D	E	F	G	H	J	K	L	M	N	P	T (LH)	T (RH)	U (LH)	U (RH)	V (LH)	V (RH)	W (LH)	W (RH)	WATER CONNECTIONS	FILTER SIZE
	WIDTH	DEPTH *	HEIGHT	FILTER RACK			RETURN AIR DUCT		WATER OUT	DRAIN PORT	WATER IN	ELECTRICAL KNOCKOUT		HEATER KNOCKOUT	SUPPLY AIR DUCT OPENING									
				HEIGHT	WIDTH	DEPTH	WIDTH	HEIGHT																
024	24.0	27.4	44.4	24.9	24.5	3.3	22.3	22.4	12.1	5.8	3.1	11.7	8.1	5.7	8.7	8.7	10.0	10.0	1.9	8.0	10.8	10.8	3/4" FPT	24 X 24 X 2 (1)
036	25.8	33.4	52.4	32.9	30.5	3.3	28.4	30.6	14.9	5.8	3.1	11.7	8.1	5.7	10.8	10.8	11.7	11.7	1.9	8.9	13.0	13.0	1" FPT	16 X 30 X 2 (2)
048	25.8	33.4	52.4	32.9	30.5	3.3	28.4	30.6	14.9	5.8	3.1	11.7	8.1	5.7	10.8	10.8	11.7	11.7	1.9	8.9	13.0	13.0	1" FPT	16 X 30 X 2 (2)
060	27.0	33.4	61.8	41.0	30.5	3.3	28.4	38.7	14.9	5.8	3.1	11.7	8.1	5.7	9.6	9.6	14.1	14.1	1.9	8.9	13.0	13.0	1" FPT	20 X 30 X 2 (2)
070	27.0	33.4	61.8	41.0	30.5	3.3	28.4	38.7	14.9	5.8	3.1	11.7	8.1	5.7	9.6	9.6	14.1	14.1	1.9	8.9	13.0	13.0	1" FPT	20 X 30 X 2 (2)

* When WSHP Open controller is installled increase depth by 1.25 inches.
† Electric heat is an optional feature.
** Condensate drain connection is 3/4-in. FPT.

NOTES:
1. All dimensions are shown within ± 0.125 inch.
2. Return air and supply air duct flanges shipped unfolded.
3. Dimensions are shown in inches.
4. Specifications subject to change without notice.



Service Access to:

COMPRESSOR CONTROLS	BLOWER AND MOTOR	REFRIGERATION COMPONENTS
36 in.	18 in.	36 in.

Dimensions (cont)

50PTH 024-070 CORNER WEIGHTS

UNIT SIZE	TOTAL (lb)	LEFT HAND EVAPORATOR				RIGHT HAND EVAPORATOR			
		LEFT FRONT* (lb)	RIGHT FRONT* (lb)	LEFT BACK (lb)	RIGHT BACK (lb)	LEFT FRONT* (lb)	RIGHT FRONT* (lb)	LEFT BACK (lb)	RIGHT BACK (lb)
024	260	60	74	68	61	60	74	61	68
036	375	94	104	95	92	94	104	92	95
048	355	84	109	88	81	84	109	81	88
060	430	107	124	104	105	107	124	105	104
070	460	117	136	105	111	117	136	111	105

* Front is control box end.

LEGEND AND NOTES FOR PAGES 17-26

LEGEND

COP — Coefficient of Performance
db — Dry Bulb
EER — Energy Efficiency Ratio
EWT — Entering Water Temperature (F)
FOH — Feet of Heat
MBtuh — Btuh in Thousands
wb — Wet Bulb

NOTES:
1. Interpolation is permissible; extrapolation is not.
2. AHRI/ISO certified conditions are 80.6 F db and 66.2 F wb in cooling and 68 F db in heating.
3. Table does not reflect fan or pump power corrections for AHRI/ISO conditions.
4. Operation below 40 F EWT is based on a 15% antifreeze solution.
5. See Carrier WSHP Builder selection software for operating conditions other than those listed.

Performance data

50PTH,PTV024

650 CFM AT 0.34-in. ESP — PART LOAD

COOLING									HEATING						
Entering Fluid Temp (F)	Water Flow (GPM)	Pressure Drop PSI (FOH)	Entering Air Temp (db/wb) F	Total Capacity (MBtuh)	Sensible Capacity (MBtuh)	Heat of Rejection (MBtuh)	Power Input (kW)	EER	Entering Fluid Temp (F)	Pressure Drop PSI (FOH)	Entering Air Temp (F)	Total Capacity (MBtuh)	Heat of Absorption (MBtuh)	Power Input (kW)	COP
50	3	0.7 (1.7)	75/63	20.0	15.8	22.5	0.77	25.8	30	0.8 (1.8)	60	12.8	9.6	1.01	3.7
			75/63	20.0	15.8	22.5	0.77	25.8			70	12.4	8.9	1.13	3.2
			80/67	21.3	16.3	23.8	0.76	27.8			80	12.1	8.1	1.26	2.8
	4	1.3 (2.9)	85/71	22.7	16.8	25.1	0.76	30.0		1.3 (3.1)	60	13.1	10.0	1.01	3.8
			75/63	20.4	16.0	22.8	0.74	27.4			70	12.7	9.2	1.13	3.3
			80/67	21.8	16.5	24.1	0.73	29.7			80	12.3	8.4	1.27	2.9
	6	2.6 (5.9)	85/71	23.2	16.9	25.6	0.72	32.1		2.8 (6.4)	60	13.5	10.4	1.02	3.9
			75/63	20.8	16.2	23.1	0.71	29.1			70	13.1	9.5	1.14	3.4
			80/67	22.2	16.7	24.5	0.70	31.5			80	12.6	8.7	1.27	2.9
60	3	0.7 (1.6)	85/71	23.7	17.1	26.0	0.69	34.3	40	0.8 (1.8)	60	14.8	11.6	1.03	4.2
			75/63	19.0	15.4	21.7	0.86	22.1			70	14.3	10.7	1.15	3.7
			80/67	20.3	15.9	23.0	0.85	23.9			80	13.9	9.9	1.28	3.2
	4	1.2 (2.8)	85/71	21.6	16.3	24.3	0.84	25.7		1.3 (3.0)	60	15.2	12.0	1.03	4.3
			75/63	19.4	15.6	22.0	0.82	23.5			70	14.9	11.2	1.15	3.8
			80/67	20.7	16.0	23.3	0.81	25.4			80	14.3	10.3	1.28	3.3
	6	2.5 (5.7)	85/71	22.0	16.5	24.6	0.80	27.4		2.7 (6.1)	60	15.7	12.5	1.03	4.5
			75/63	19.8	15.7	22.3	0.79	25.0			70	15.4	11.6	1.15	3.9
			80/67	21.1	16.2	23.6	0.78	27.0			80	14.7	10.7	1.29	3.4
70	3	0.7 (1.6)	85/71	22.5	16.7	25.0	0.77	29.3	50	0.7 (1.7)	60	16.9	13.6	1.04	4.8
			75/63	18.0	15.0	21.0	0.96	18.7			70	16.4	12.7	1.16	4.2
			80/67	19.2	15.5	22.2	0.95	20.2			80	16.0	11.8	1.30	3.6
	4	1.2 (2.7)	85/71	20.4	16.0	23.4	0.94	21.6		1.2 (2.9)	60	17.4	14.2	1.04	4.9
			75/63	18.3	15.1	21.2	0.92	19.8			70	16.9	13.2	1.16	4.3
			80/67	19.6	15.6	22.5	0.91	21.5			80	16.5	12.3	1.30	3.7
	6	2.4 (5.5)	85/71	20.9	16.1	23.7	0.90	23.2		2.6 (5.9)	60	18.1	14.8	1.04	5.1
			75/63	18.7	15.3	21.5	0.89	21.1			70	17.4	13.7	1.16	4.4
			80/67	20.0	15.8	22.8	0.87	22.9			80	16.9	12.7	1.30	3.8
80	3	0.6 (1.5)	85/71	21.3	16.3	24.1	0.86	24.7	60	0.7 (1.6)	60	19.0	15.8	1.04	5.4
			75/63	17.0	14.5	20.2	1.08	15.8			70	18.5	14.8	1.17	4.7
			80/67	18.1	15.1	21.4	1.07	16.9			80	18.0	13.8	1.31	4.0
	4	1.1 (2.6)	85/71	19.3	15.5	22.6	1.06	18.2		1.2 (2.8)	60	19.7	16.4	1.04	5.6
			75/63	17.3	14.6	20.5	1.04	16.7			70	19.1	15.4	1.17	4.8
			80/67	18.5	15.2	21.6	1.03	18.0			80	18.6	14.4	1.31	4.2
	6	2.3 (5.4)	85/71	19.7	15.7	22.9	1.02	19.4		2.5 (5.7)	60	20.4	17.1	1.04	5.8
			75/63	17.6	14.8	20.7	1.00	17.6			70	19.7	16.0	1.17	4.9
			80/67	18.9	15.3	21.9	0.99	19.1			80	19.1	14.9	1.31	4.3
85	3	0.6 (1.5)	85/71	20.1	15.9	23.1	0.97	20.7	70	0.7 (1.6)	60	21.3	18.0	1.04	6.0
			75/63	16.4	14.3	19.9	1.14	14.4			70	20.7	16.9	1.17	5.2
			80/67	17.5	14.9	21.0	1.13	15.4			80	20.1	15.9	1.32	4.5
	4	1.1 (2.5)	85/71	18.7	15.3	22.2	1.13	16.6		1.2 (2.7)	60	22.0	18.7	1.04	6.2
			75/63	16.8	14.4	20.1	1.10	15.2			70	21.3	17.6	1.17	5.3
			80/67	17.9	15.0	21.2	1.09	16.4			80	20.7	16.5	1.32	4.6
	6	2.3 (5.3)	85/71	19.1	15.5	22.4	1.08	17.6		2.4 (5.5)	60	22.8	19.5	1.04	6.5
			75/63	17.1	14.6	20.3	1.06	16.1			70	22.1	18.3	1.17	5.6
			80/67	18.3	15.1	21.5	1.05	17.4			80	21.4	17.1	1.32	4.7
90	3	0.6 (1.5)	85/71	19.5	15.6	22.7	1.03	18.8	80	0.7 (1.5)	60	23.5	20.3	1.03	6.7
			75/63	15.9	14.1	19.5	1.21	13.1			70	22.9	19.2	1.17	5.8
			80/67	17.0	14.6	20.7	1.20	14.1			80	22.3	18.0	1.32	5.0
	4	1.1 (2.5)	85/71	18.1	15.1	21.8	1.20	15.1		1.1 (2.6)	60	24.4	21.1	1.03	7.0
			75/63	16.2	14.2	19.7	1.17	13.8			70	23.6	19.9	1.16	6.0
			80/67	17.3	14.8	20.9	1.16	14.9			80	22.9	18.7	1.32	5.1
	6	2.3 (5.2)	85/71	18.5	15.3	22.0	1.15	16.1		2.3 (5.4)	60	25.3	22.1	1.03	7.2
			75/63	16.5	14.3	20.0	1.13	14.6			70	24.4	20.8	1.16	6.2
			80/67	17.7	14.9	21.1	1.12	15.8			80	23.7	19.5	1.32	5.3
100	3	0.6 (1.4)	85/71	18.9	15.4	22.3	1.10	17.1	Operation Not Recommended						
			75/63	14.8	13.6	18.9	1.36	10.9							
			80/67	15.8	14.2	19.9	1.36	11.6							
	4	1.0 (2.4)	85/71	16.9	14.7	21.0	1.35	12.5							
			75/63	15.1	13.7	19.0	1.32	11.4							
			80/67	16.2	14.3	20.1	1.31	12.3							
	6	2.2 (5.0)	85/71	17.2	14.9	21.2	1.30	13.2							
			75/63	15.4	13.9	19.2	1.28	12.0							
			80/67	16.5	14.4	20.3	1.26	13.0							
110	3	0.6 (1.4)	85/71	17.6	15.0	21.5	1.25	14.0							
			75/63	13.7	13.2	18.3	1.53	9.0							
			80/67	14.7	13.7	19.3	1.53	9.6							
	4	1.0 (2.4)	85/71	15.7	14.3	20.3	1.52	10.3							
			75/63	14.0	13.3	18.4	1.48	9.4							
			80/67	15.0	13.9	19.4	1.48	10.1							
	6	2.1 (4.9)	85/71	16.0	14.4	20.5	1.47	10.8							
			75/63	14.2	13.4	18.5	1.44	9.8							
			80/67	15.3	14.0	19.6	1.43	10.6							

Performance data (cont)

50PTH,PTV024

825 CFM AT 0.23-in. ESP — FULL LOAD

COOLING									HEATING						
Entering Fluid Temp (F)	Water Flow (GPM)	Pressure Drop PSI (FOH)	Entering Air Temp (db/wb) F	Total Capacity (MBtuh)	Sensible Capacity (MBtuh)	Heat of Rejection (MBtuh)	Power Input (kW)	EER	Entering Fluid Temp (F)	Pressure Drop PSI (FOH)	Entering Air Temp (F)	Total Capacity (MBtuh)	Heat of Absorption (MBtuh)	Power Input (kW)	COP
50	3	0.7 (1.7)	75/63	27.1	20.7	31.3	1.27	21.4	30	0.8 (1.8)	60	18.1	13.5	1.38	3.8
			80/67	28.9	21.2	33.1	1.29	22.5			70	17.6	12.6	1.52	3.4
			85/71	30.7	21.8	35.0	1.30	23.6			80	17.4	11.7	1.67	3.0
	4	1.3 (2.9)	75/63	27.8	21.0	31.8	1.20	23.1		1.3 (3.1)	60	18.6	14.1	1.39	3.9
			80/67	29.6	21.6	33.6	1.22	24.3			70	18.2	13.1	1.53	3.5
			85/71	31.5	22.1	35.6	1.24	25.5			80	17.8	12.2	1.68	3.1
	6	2.6 (5.9)	75/63	28.5	21.3	32.3	1.14	25.1		2.8 (6.4)	60	19.3	14.7	1.41	4.0
			80/67	30.4	21.9	34.2	1.15	26.5			70	18.8	13.7	1.55	3.6
			85/71	32.4	22.4	36.3	1.16	27.9			80	18.4	12.7	1.69	3.2
60	3	0.7 (1.6)	75/63	25.9	20.2	30.4	1.38	18.8	40	0.8 (1.8)	60	20.4	15.7	1.43	4.2
			80/67	27.5	20.8	32.1	1.40	19.7			70	20.0	14.8	1.57	3.7
			85/71	29.3	21.3	34.0	1.41	20.8			80	19.6	13.9	1.72	3.3
	4	1.2 (2.8)	75/63	26.6	20.4	30.9	1.32	20.2		1.3 (3.0)	60	21.2	16.5	1.44	4.3
			80/67	28.2	21.1	32.6	1.34	21.1			70	20.7	15.5	1.58	3.8
			85/71	30.1	21.6	34.5	1.35	22.4			80	20.2	14.5	1.74	3.4
	6	2.5 (5.7)	75/63	27.2	20.7	31.4	1.26	21.6		2.7 (6.1)	60	22.0	17.3	1.46	4.4
			80/67	29.0	21.3	33.2	1.27	22.8			70	21.5	16.2	1.60	3.9
			85/71	30.9	22.0	35.2	1.28	24.2			80	20.9	15.1	1.75	3.5
70	3	0.7 (1.6)	75/63	24.6	19.7	29.4	1.49	16.5	50	0.7 (1.7)	60	23.1	18.2	1.48	4.6
			80/67	26.2	20.2	31.1	1.51	17.3			70	22.5	17.2	1.62	4.1
			85/71	27.9	20.8	32.9	1.53	18.3			80	22.1	16.1	1.78	3.6
	4	1.2 (2.7)	75/63	25.2	19.9	29.9	1.44	17.6		1.2 (2.9)	60	24.0	19.0	1.50	4.7
			80/67	26.9	20.5	31.6	1.45	18.5			70	23.4	18.0	1.64	4.2
			85/71	28.6	21.1	33.4	1.46	19.6			80	22.9	16.8	1.80	3.7
	6	2.4 (5.5)	75/63	25.9	20.1	30.4	1.38	18.8		2.6 (5.9)	60	25.2	20.0	1.52	4.8
			80/67	27.6	20.8	32.1	1.39	19.9			70	24.4	18.9	1.66	4.3
			85/71	29.5	21.3	34.1	1.40	21.1			80	23.8	17.7	1.82	3.8
80	3	0.6 (1.5)	75/63	23.4	19.1	28.5	1.62	14.4	60	0.7 (1.6)	60	25.9	20.8	1.54	4.9
			80/67	24.9	19.7	30.1	1.64	15.2			70	25.3	19.8	1.68	4.4
			85/71	26.4	20.3	31.8	1.66	16.0			80	24.9	18.6	1.83	4.0
	4	1.1 (2.6)	75/63	23.9	19.3	29.0	1.56	15.3		1.2 (2.8)	60	27.0	21.8	1.55	5.1
			80/67	25.5	20.0	30.6	1.58	16.2			70	26.3	20.8	1.69	4.5
			85/71	27.2	20.5	32.4	1.59	17.1			80	25.8	19.5	1.85	4.1
	6	2.3 (5.4)	75/63	24.5	19.6	29.4	1.50	16.3		2.5 (5.7)	60	28.2	23.1	1.58	5.2
			80/67	26.2	20.3	31.1	1.52	17.3			70	27.5	21.8	1.72	4.7
			85/71	28.0	20.8	32.9	1.52	18.4			80	26.8	20.5	1.87	4.2
85	3	0.6 (1.5)	75/63	22.7	18.8	28.0	1.69	13.4	70	0.7 (1.6)	60	28.8	23.6	1.59	5.3
			80/67	24.1	19.5	29.6	1.71	14.1			70	28.2	22.5	1.73	4.8
			85/71	25.7	20.1	31.3	1.73	14.9			80	27.6	21.3	1.89	4.3
	4	1.1 (2.5)	75/63	23.3	19.0	28.5	1.63	14.3		1.2 (2.7)	60	30.4	24.8	1.61	5.5
			80/67	24.8	19.7	30.1	1.65	15.1			70	29.3	23.6	1.75	4.9
			85/71	26.4	20.3	31.8	1.66	16.0			80	29.0	22.2	1.91	4.4
	6	2.3 (5.3)	75/63	23.9	19.3	28.9	1.57	15.2		2.4 (5.5)	60	31.6	26.2	1.63	5.7
			80/67	25.4	20.0	30.5	1.58	16.1			70	30.7	24.9	1.77	5.1
			85/71	27.2	20.5	32.4	1.59	17.1			80	30.2	23.4	1.93	4.6
90	3	0.6 (1.5)	75/63	22.0	18.5	27.7	1.77	12.5	80	0.7 (1.5)	60	32.2	26.5	1.64	5.8
			80/67	23.5	19.2	29.2	1.79	13.2			70	31.1	25.3	1.78	5.1
			85/71	24.9	19.8	30.7	1.80	13.9			80	30.8	23.9	1.94	4.6
	4	1.1 (2.5)	75/63	22.5	18.8	28.0	1.71	13.2		1.1 (2.6)	60	33.7	27.9	1.66	5.9
			80/67	24.0	19.4	29.5	1.72	14.0			70	32.5	26.6	1.81	5.3
			85/71	25.7	20.0	31.3	1.73	14.9			80	31.7	25.2	1.97	4.7
	6	2.3 (5.2)	75/63	23.2	19.0	28.4	1.64	14.1		2.3 (5.4)	60	35.0	29.5	1.69	6.1
			80/67	24.7	19.6	30.0	1.66	14.9			70	34.0	28.0	1.83	5.4
			85/71	26.4	20.3	31.7	1.66	15.9			80	33.4	26.3	2.00	4.9
100	3	0.6 (1.4)	75/63	20.7	18.0	26.8	1.93	10.7	Operation Not Recommended						
			80/67	22.1	18.7	28.3	1.95	11.4							
			85/71	23.6	19.3	29.8	1.97	12.0							
	4	1.0 (2.4)	75/63	21.2	18.2	27.1	1.87	11.4							
			80/67	22.7	18.9	28.7	1.88	12.1							
			85/71	24.1	19.5	30.2	1.89	12.8							
	6	2.2 (5.0)	75/63	21.7	18.4	27.4	1.80	12.1							
			80/67	23.2	19.1	29.0	1.81	12.8							
			85/71	24.8	19.7	30.7	1.82	13.7							
110	3	0.6 (1.4)	75/63	19.4	17.5	26.1	2.12	9.2							
			80/67	20.7	18.2	27.5	2.14	9.7							
			85/71	22.1	18.8	28.9	2.16	10.3							
	4	1.0 (2.4)	75/63	19.9	17.6	26.4	2.06	9.7							
			80/67	21.3	18.3	27.8	2.07	10.3							
			85/71	22.7	19.0	29.3	2.08	11.0							
	6	2.1 (4.9)	75/63	20.4	17.8	26.6	1.99	10.3							
			80/67	21.8	18.6	28.1	1.99	11.0							
			85/71	23.3	19.2	29.7	2.00	11.7							

See Legend and Notes on page 16.

50PTH,PTV036

800 CFM AT 0.58-in. ESP — PART LOAD

COOLING									HEATING						
Entering Fluid Temp (F)	Water Flow (GPM)	Pressure Drop PSI (FOH)	Entering Air Temp (db/wb) F	Total Capacity (MBtuh)	Sensible Capacity (MBtuh)	Heat of Rejection (MBtuh)	Power Input (kW)	EER	Entering Fluid Temp (F)	Pressure Drop PSI (FOH)	Entering Air Temp (F)	Total Capacity (MBtuh)	Heat of Absorption (MBtuh)	Power Input (kW)	COP
50	4.5	1.4 (3.2)	75/63	29.9	21.8	33.2	1.01	29.6	30	1.5 (3.4)	60	18.4	13.6	1.46	3.7
			80/67	32.0	22.4	35.3	1.00	32.1			70	17.9	12.5	1.65	3.2
			85/71	34.2	23.0	37.5	0.98	34.9			80	17.7	11.4	1.87	2.8
	6.0	2.3 (5.4)	75/63	30.4	22.0	33.6	0.99	30.9		2.5 (5.7)	60	18.8	14.0	1.47	3.8
			80/67	32.5	22.7	35.7	0.97	33.6			70	18.3	12.9	1.65	3.2
			85/71	34.8	23.3	38.0	0.95	36.7			80	18.0	11.7	1.87	2.8
	9.0	4.8 (11.1)	75/63	30.8	22.2	34.0	0.96	32.0		5.2 (11.9)	60	19.3	14.5	1.47	3.8
			80/67	33.1	22.8	36.2	0.94	35.1			70	18.9	13.4	1.66	3.3
			85/71	35.4	23.5	38.5	0.92	38.5			80	18.3	12.4	1.87	2.9
60	4.5	1.3 (3.1)	75/63	28.5	21.2	32.1	1.11	25.7	40	1.4 (3.3)	60	21.3	16.4	1.48	4.2
			80/67	30.5	21.9	34.1	1.10	27.9			70	20.8	15.3	1.67	3.6
			85/71	32.7	22.4	36.3	1.08	30.3			80	20.3	14.1	1.89	3.1
	6.0	2.3 (5.2)	75/63	29.0	21.4	32.4	1.07	27.0		2.4 (5.5)	60	21.9	17.0	1.49	4.3
			80/67	31.1	22.1	34.5	1.06	29.4			70	21.3	15.8	1.67	3.7
			85/71	33.3	22.6	36.7	1.04	32.0			80	20.8	14.5	1.89	3.2
	9.0	4.6 (10.7)	75/63	29.4	21.6	32.8	1.04	28.2		5.0 (11.5)	60	22.5	17.6	1.49	4.4
			80/67	31.6	22.3	34.9	1.02	30.9			70	21.9	16.3	1.68	3.8
			85/71	33.9	22.9	37.2	1.00	33.9			80	21.4	15.1	1.90	3.3
70	4.5	1.3 (3.0)	75/63	27.1	20.6	31.0	1.23	22.0	50	1.4 (3.2)	60	24.4	19.4	1.50	4.8
			80/67	29.1	21.2	33.0	1.22	23.8			70	23.8	18.1	1.69	4.1
			85/71	31.1	21.9	35.0	1.21	25.7			80	23.5	16.8	1.92	3.6
	6.0	2.2 (5.0)	75/63	27.5	20.8	31.3	1.19	23.1		2.3 (5.4)	60	25.1	20.1	1.51	4.9
			80/67	29.6	21.4	33.4	1.18	25.1			70	24.4	18.8	1.70	4.2
			85/71	31.7	22.1	35.5	1.16	27.2			80	23.9	17.5	1.92	3.6
	9.0	4.5 (10.4)	75/63	27.9	21.0	31.7	1.16	24.2		4.8 (11.1)	60	25.9	20.9	1.51	5.0
			80/67	30.0	21.6	33.7	1.14	26.4			70	25.1	19.5	1.70	4.3
			85/71	32.3	22.2	35.9	1.12	28.9			80	24.6	18.1	1.93	3.7
80	4.5	1.3 (2.9)	75/63	25.7	19.9	30.1	1.39	18.5	60	1.3 (3.1)	60	27.6	22.6	1.52	5.3
			80/67	27.5	20.7	31.9	1.38	19.9			70	26.9	21.2	1.72	4.6
			85/71	29.5	21.3	33.9	1.37	21.5			80	26.3	19.6	1.95	4.0
	6.0	2.1 (4.8)	75/63	26.1	20.1	30.3	1.35	19.4		2.2 (5.2)	60	28.4	23.4	1.52	5.5
			80/67	28.0	20.8	32.3	1.33	21.0			70	27.7	22.0	1.73	4.7
			85/71	30.1	21.4	34.3	1.32	22.8			80	27.0	20.5	1.95	4.0
	9.0	4.4 (10.1)	75/63	26.5	20.3	30.6	1.30	20.4		4.6 (10.7)	60	29.4	24.4	1.53	5.6
			80/67	28.4	21.0	32.6	1.29	22.1			70	28.5	22.8	1.73	4.8
			85/71	30.5	21.7	34.6	1.27	24.1			80	28.0	21.1	1.97	4.2
85	4.5	1.2 (2.8)	75/63	24.9	19.7	29.6	1.48	16.8	70	1.3 (3.0)	60	30.9	25.9	1.54	5.9
			80/67	26.8	20.3	31.5	1.47	18.2			70	30.0	24.2	1.74	5.0
			85/71	28.7	21.0	33.4	1.47	19.6			80	29.7	22.7	1.99	4.4
	6.0	2.1 (4.8)	75/63	25.3	19.8	29.9	1.43	17.7		2.2 (5.0)	60	31.9	26.9	1.54	6.1
			80/67	27.2	20.5	31.7	1.42	19.2			70	31.0	25.3	1.75	5.2
			85/71	29.2	21.2	33.7	1.41	20.8			80	30.3	23.6	1.99	4.5
	9.0	4.3 (9.9)	75/63	25.7	19.9	30.1	1.39	18.5		4.5 (10.4)	60	33.0	28.0	1.54	6.3
			80/67	27.6	20.7	32.0	1.37	20.1			70	32.0	26.3	1.76	5.3
			85/71	29.7	21.3	34.1	1.35	21.9			80	31.2	24.4	2.00	4.6
90	4.5	1.2 (2.8)	75/63	24.1	19.3	29.1	1.58	15.3	80	1.2 (2.9)	60	34.4	28.7	1.55	6.5
			80/67	26.0	20.1	30.9	1.57	16.6			70	33.2	27.5	1.77	5.5
			85/71	27.9	20.7	32.8	1.57	17.8			80	32.8	25.8	2.02	4.8
	6.0	2.0 (4.7)	75/63	24.5	19.5	29.3	1.53	16.0		2.1 (4.8)	60	35.4	30.5	1.55	6.7
			80/67	26.4	20.2	31.3	1.52	17.4			70	34.4	28.6	1.78	5.7
			85/71	28.4	20.8	33.2	1.51	18.9			80	33.8	26.4	2.03	4.9
	9.0	4.2 (9.7)	75/63	24.9	19.6	29.6	1.48	16.8		4.4 (10.1)	60	36.7	31.8	1.56	6.9
			80/67	26.8	20.3	31.5	1.47	18.3			70	35.6	29.9	1.79	5.8
			85/71	28.8	21.0	33.5	1.45	19.9			80	35.0	27.6	2.04	5.0
100	4.5	1.2 (2.7)	75/63	22.7	18.7	28.3	1.80	12.7	Operation Not Recommended						
			80/67	24.4	19.4	30.0	1.79	13.6							
			85/71	26.2	20.0	31.9	1.79	14.7							
	6.0	2.0 (4.6)	75/63	23.0	18.9	28.5	1.74	13.2							
			80/67	24.8	19.5	30.3	1.73	14.3							
			85/71	26.6	20.3	32.1	1.72	15.5							
	9.0	4.1 (9.5)	75/63	23.3	19.0	28.7	1.69	13.8							
			80/67	25.1	19.7	30.4	1.68	14.9							
			85/71	27.1	20.4	32.4	1.67	16.3							
110	4.5	1.1 (2.6)	75/63	21.1	18.1	27.5	2.04	10.3							
			80/67	22.8	18.8	29.2	2.04	11.2							
			85/71	24.5	19.5	30.9	2.03	12.1							
	6.0	1.9 (4.4)	75/63	21.4	18.2	27.7	1.99	10.8							
			80/67	23.1	19.0	29.4	1.98	11.7							
			85/71	24.9	19.6	31.1	1.97	12.6							
	9.0	4.0 (9.2)	75/63	21.8	18.3	27.8	1.94	11.3							
			80/67	23.5	19.1	29.5	1.92	12.2							
			85/71	25.3	19.7	31.4	1.91	13.2							

Performance data (cont)

Carrier
United Technologies

50PTH,PTV036

1,100 CFM AT 0.25-in. ESP — FULL LOAD

COOLING									HEATING						
Entering Fluid Temp (F)	Water Flow (GPM)	Pressure Drop PSI (FOH)	Entering Air Temp (db/wb) F	Total Capacity (MBtuh)	Sensible Capacity (MBtuh)	Heat of Rejection (MBtuh)	Power Input (kW)	EER	Entering Fluid Temp (F)	Pressure Drop PSI (FOH)	Entering Air Temp (F)	Total Capacity (MBtuh)	Heat of Absorption (MBtuh)	Power Input (kW)	COP
50	4.5	1.4 (3.2)	75/63	40.9	29.9	46.4	1.69	24.2	30	1.5 (3.4)	60	25.9	19.5	1.93	3.9
			80/67	43.6	30.6	49.3	1.74	25.1			70	25.6	18.3	2.15	3.5
			85/71	46.4	31.4	52.3	1.78	26.1			80	25.6	17.1	2.40	3.1
	6.0	2.3 (5.4)	75/63	41.6	30.2	47.0	1.64	25.3		2.5 (5.7)	60	26.8	20.2	1.95	4.0
			80/67	44.4	31.0	50.0	1.69	26.4			70	26.3	19.0	2.17	3.5
			85/71	47.4	31.7	53.1	1.73	27.4			80	26.3	17.7	2.42	3.2
	9.0	4.8 (11.1)	75/63	42.4	30.6	47.7	1.60	26.6		5.2 (11.9)	60	27.7	21.1	1.97	4.1
			80/67	45.3	31.4	50.7	1.64	27.6			70	27.2	19.8	2.19	3.6
			85/71	48.3	32.1	54.0	1.69	28.7			80	27.1	18.3	2.44	3.3
60	4.5	1.3 (3.1)	75/63	39.2	29.1	45.2	1.82	21.6	40	1.4 (3.3)	60	29.6	22.9	2.01	4.3
			80/67	41.8	30.0	47.9	1.86	22.5			70	29.1	21.6	2.23	3.8
			85/71	44.6	30.7	50.8	1.89	23.6			80	28.7	20.3	2.48	3.4
	6.0	2.3 (5.2)	75/63	40.0	29.4	45.7	1.76	22.7		2.4 (5.5)	60	30.7	23.9	2.03	4.4
			80/67	42.6	30.3	48.5	1.79	23.8			70	30.1	22.5	2.25	3.9
			85/71	45.5	31.1	51.5	1.83	24.9			80	29.5	21.1	2.50	3.4
	9.0	4.6 (10.7)	75/63	40.7	29.8	46.3	1.71	23.9		5.0 (11.5)	60	31.9	25.0	2.05	4.5
			80/67	43.5	30.5	49.3	1.74	25.0			70	31.1	23.5	2.28	4.0
			85/71	46.4	31.4	52.3	1.78	26.2			80	30.5	22.0	2.53	3.5
70	4.5	1.3 (3.0)	75/63	37.5	28.4	43.9	1.97	19.0	50	1.4 (3.2)	60	33.6	26.6	2.09	4.7
			80/67	40.0	29.1	46.6	2.01	19.9			70	32.9	25.1	2.32	4.2
			85/71	42.6	30.0	49.3	2.04	20.9			80	32.8	23.5	2.57	3.7
	6.0	2.2 (5.0)	75/63	38.2	28.7	44.4	1.91	20.1		2.3 (5.4)	60	34.9	27.8	2.12	4.8
			80/67	40.8	29.5	47.2	1.94	21.1			70	34.1	26.2	2.34	4.3
			85/71	43.5	30.4	50.0	1.96	22.2			80	34.1	24.5	2.60	3.8
	9.0	4.5 (10.4)	75/63	38.9	29.0	44.9	1.85	21.1		4.8 (11.1)	60	36.3	29.1	2.15	4.9
			80/67	41.6	29.8	47.8	1.87	22.2			70	35.4	27.5	2.37	4.4
			85/71	44.5	30.6	50.8	1.90	23.4			80	35.3	25.5	2.62	3.9
80	4.5	1.3 (2.9)	75/63	35.7	27.7	42.7	2.16	16.5	60	1.3 (3.1)	60	37.8	30.5	2.18	5.1
			80/67	38.1	28.5	45.2	2.19	17.4			70	37.0	28.9	2.40	4.5
			85/71	40.7	29.3	47.9	2.22	18.4			80	36.3	27.3	2.65	4.0
	6.0	2.1 (4.8)	75/63	36.5	27.9	43.2	2.09	17.5		2.2 (5.2)	60	39.3	31.9	2.21	5.2
			80/67	38.9	28.8	45.7	2.11	18.5			70	38.4	30.2	2.43	4.6
			85/71	41.6	29.6	48.5	2.13	19.5			80	37.6	28.5	2.68	4.1
	9.0	4.4 (10.1)	75/63	37.1	28.2	43.6	2.02	18.4		4.6 (10.7)	60	41.0	33.5	2.25	5.3
			80/67	39.6	29.1	46.3	2.04	19.5			70	40.0	31.7	2.46	4.8
			85/71	42.5	29.8	49.2	2.06	20.7			80	39.0	29.8	2.71	4.2
85	4.5	1.2 (2.8)	75/63	34.8	27.3	42.1	2.27	15.4	70	1.3 (3.0)	60	42.2	34.6	2.27	5.4
			80/67	37.2	28.1	44.6	2.29	16.2			70	41.2	32.8	2.49	4.8
			85/71	39.8	28.8	47.3	2.32	17.2			80	40.4	31.1	2.75	4.3
	6.0	2.1 (4.8)	75/63	35.5	27.6	42.5	2.19	16.2		2.2 (5.0)	60	44.0	36.2	2.31	5.6
			80/67	38.0	28.4	45.2	2.21	17.2			70	42.9	34.4	2.53	5.0
			85/71	40.5	29.2	47.8	2.23	18.2			80	41.9	32.5	2.78	4.4
	9.0	4.3 (9.9)	75/63	36.1	27.7	43.0	2.12	17.0		4.5 (10.4)	60	46.0	38.1	2.36	5.7
			80/67	38.6	28.7	45.6	2.14	18.1			70	44.7	36.1	2.57	5.1
			85/71	41.4	29.5	48.4	2.15	19.3			80	43.5	34.0	2.82	4.5
90	4.5	1.2 (2.8)	75/63	34.0	26.8	41.6	2.38	14.3	80	1.2 (2.9)	60	46.7	38.8	2.37	5.8
			80/67	36.3	27.7	44.1	2.41	15.1			70	46.0	36.8	2.59	5.2
			85/71	38.8	28.5	46.6	2.43	16.0			80	44.6	35.0	2.85	4.6
	6.0	2.0 (4.7)	75/63	34.6	27.2	42.0	2.30	15.1		2.1 (4.8)	60	48.8	40.7	2.42	5.9
			80/67	37.0	28.1	44.5	2.32	16.0			70	47.5	38.6	2.64	5.3
			85/71	39.5	28.9	47.1	2.34	16.9			80	46.4	36.6	2.89	4.7
	9.0	4.2 (9.7)	75/63	35.2	27.4	42.3	2.23	15.8		4.4 (10.1)	60	51.1	42.8	2.48	6.0
			80/67	37.7	28.2	45.0	2.25	16.8			70	49.6	40.6	2.69	5.4
			85/71	40.4	29.1	47.7	2.26	17.9			80	48.2	38.3	2.94	4.8
100	4.5	1.2 (2.7)	75/63	32.1	26.1	40.5	2.63	12.2	Operation Not Recommended						
			80/67	34.4	26.9	43.0	2.66	13.0							
			85/71	36.7	27.9	45.3	2.68	13.7							
	6.0	2.0 (4.6)	75/63	32.7	26.3	40.9	2.55	12.8							
			80/67	35.0	27.3	43.3	2.57	13.7							
			85/71	37.4	28.1	45.8	2.58	14.5							
	9.0	4.1 (9.5)	75/63	33.3	26.6	41.2	2.47	13.5							
			80/67	35.7	27.5	43.7	2.48	14.4							
			85/71	38.1	28.4	46.2	2.49	15.3							
110	4.5	1.1 (2.6)	75/63	30.3	25.3	39.7	2.92	10.4							
			80/67	32.4	26.3	41.9	2.94	11.0							
			85/71	34.7	27.1	44.3	2.96	11.7							
	6.0	1.9 (4.4)	75/63	30.8	25.5	39.9	2.84	10.9							
			80/67	33.1	26.5	42.2	2.85	11.6							
			85/71	35.4	27.3	44.6	2.86	12.4							
	9.0	4.0 (9.2)	75/63	31.5	25.8	40.2	2.74	11.5							
			80/67	33.7	26.7	42.6	2.75	12.3							
			85/71	36.1	27.6	45.0	2.77	13.1							

See Legend and Notes on page 16.

50PTH,PTV048

1,300 CFM AT 0.27-in. ESP — PART LOAD

COOLING									HEATING						
Entering Fluid Temp (F)	Water Flow (GPM)	Pressure Drop PSI (FOH)	Entering Air Temp (db/wb) F	Total Capacity (MBtuh)	Sensible Capacity (MBtuh)	Heat of Rejection (MBtuh)	Power Input (kW)	EER	Entering Fluid Temp (F)	Pressure Drop PSI (FOH)	Entering Air Temp (F)	Total Capacity (MBtuh)	Heat of Absorption (MBtuh)	Power Input (kW)	COP
50	6	1.1 (2.6)	75/63	39.8	31.6	44.5	1.43	27.8	30	1.2 (2.8)	60	25.7	19.3	1.95	3.9
			80/67	42.6	32.6	47.2	1.41	30.2			70	24.8	17.7	2.18	3.3
			85/71	45.3	33.5	49.9	1.39	32.7			80	24.0	16.0	2.44	2.9
	8	1.9 (4.4)	75/63	40.7	32.0	45.2	1.36	30.0		2.0 (4.7)	60	26.4	20.0	1.95	4.0
			80/67	43.6	33.0	47.9	1.33	32.8			70	25.5	18.3	2.18	3.4
			85/71	46.4	34.0	50.7	1.30	35.8			80	24.6	16.6	2.44	3.0
	12	3.9 (9.1)	75/63	41.7	32.4	45.9	1.28	32.6		4.2 (9.8)	60	27.2	20.8	1.95	4.1
			80/67	44.6	33.4	48.7	1.24	35.8			70	26.2	19.0	2.18	3.5
			85/71	47.6	34.3	51.7	1.21	39.4			80	25.2	17.2	2.45	3.0
60	6	1.1 (2.5)	75/63	37.7	30.6	43.0	1.63	23.1	40	1.2 (2.7)	60	29.3	22.9	1.96	4.4
			80/67	40.3	31.7	45.5	1.61	25.1			70	28.4	21.1	2.20	3.8
			85/71	43.0	32.6	48.2	1.58	27.1			80	27.6	19.4	2.47	3.3
	8	1.9 (4.3)	75/63	38.5	31.1	43.5	1.55	24.8		2.0 (4.6)	60	30.2	23.8	1.96	4.5
			80/67	41.2	32.1	46.2	1.52	27.0			70	29.2	21.9	2.20	3.9
			85/71	44.0	33.1	48.9	1.49	29.5			80	28.3	20.1	2.47	3.4
	12	3.8 (8.8)	75/63	39.4	31.4	44.2	1.47	26.8		4.1 (9.5)	60	31.2	24.7	1.96	4.7
			80/67	42.2	32.5	46.9	1.44	29.4			70	30.1	22.8	2.21	4.0
			85/71	45.2	33.4	49.8	1.40	32.2			80	29.1	20.9	2.48	3.4
70	6	1.1 (2.5)	75/63	35.5	29.7	41.4	1.85	19.2	50	1.1 (2.6)	60	33.3	26.8	1.97	5.0
			80/67	38.0	30.9	43.8	1.82	20.8			70	32.3	24.9	2.22	4.3
			85/71	40.6	31.8	46.5	1.80	22.5			80	31.4	23.1	2.50	3.7
	8	1.8 (4.1)	75/63	36.3	30.0	41.9	1.77	20.5		1.9 (4.4)	60	34.4	27.9	1.97	5.1
			80/67	38.9	31.2	44.5	1.74	22.4			70	33.3	25.9	2.22	4.4
			85/71	41.5	32.2	47.1	1.71	24.3			80	32.4	23.9	2.50	3.8
	12	3.7 (8.6)	75/63	37.1	30.4	42.5	1.69	22.0		4.0 (9.1)	60	35.6	29.1	1.97	5.3
			80/67	39.7	31.6	45.1	1.65	24.0			70	34.4	27.0	2.23	4.5
			85/71	42.6	32.5	47.9	1.62	26.3			80	33.4	24.9	2.50	3.9
80	6	1.0 (2.4)	75/63	33.2	28.9	39.8	2.09	15.9	60	1.1 (2.5)	60	37.5	31.0	1.98	5.5
			80/67	35.6	30.0	42.2	2.07	17.2			70	36.5	29.0	2.23	4.8
			85/71	38.2	31.0	44.8	2.05	18.7			80	35.5	27.1	2.51	4.1
	8	1.7 (4.0)	75/63	33.9	29.2	40.3	2.01	16.9		1.8 (4.3)	60	38.9	32.3	1.98	5.8
			80/67	36.4	30.3	42.8	1.98	18.4			70	37.7	30.2	2.24	4.9
			85/71	39.0	31.4	45.3	1.95	20.0			80	36.6	28.2	2.52	4.3
	12	3.6 (8.3)	75/63	34.7	29.5	40.8	1.92	18.0		3.8 (8.8)	60	40.3	33.8	1.98	6.0
			80/67	37.3	30.6	43.4	1.89	19.7			70	39.0	31.6	2.24	5.1
			85/71	40.0	31.7	46.0	1.86	21.5			80	37.8	29.4	2.52	4.4
85	6	1.0 (2.3)	75/63	32.1	28.4	39.2	2.22	14.5	70	1.1 (2.5)	60	42.0	35.5	1.98	6.2
			80/67	34.5	29.5	41.5	2.20	15.7			70	40.9	33.4	2.24	5.3
			85/71	37.0	30.6	44.0	2.18	17.0			80	39.8	31.3	2.53	4.6
	8	1.7 (3.9)	75/63	32.8	28.7	39.6	2.13	15.4		1.8 (4.1)	60	43.6	37.1	1.98	6.4
			80/67	35.3	29.8	42.0	2.11	16.7			70	42.3	34.8	2.25	5.5
			85/71	37.8	30.8	44.5	2.08	18.1			80	41.1	32.6	2.54	4.8
	12	3.5 (8.1)	75/63	33.5	29.0	40.0	2.05	16.3		3.7 (8.6)	60	45.3	38.8	1.98	6.7
			80/67	36.0	30.2	42.5	2.02	17.8			70	43.9	36.4	2.25	5.7
			85/71	38.7	31.3	45.1	1.99	19.5			80	42.5	34.0	2.54	4.9
90	6	1.0 (2.3)	75/63	31.0	28.0	38.4	2.35	13.2	80	1.0 (2.4)	60	46.7	40.2	1.98	6.9
			80/67	33.3	29.1	40.7	2.34	14.2			70	45.5	38.0	2.25	5.9
			85/71	35.7	30.2	43.1	2.32	15.4			80	44.3	35.8	2.55	5.1
	8	1.7 (3.9)	75/63	31.7	28.2	38.9	2.27	14.0		1.7 (4.0)	60	48.5	42.0	1.98	7.2
			80/67	34.0	29.4	41.2	2.25	15.1			70	47.1	39.6	2.26	6.1
			85/71	36.6	30.4	43.7	2.22	16.5			80	45.8	37.2	2.55	5.3
	12	3.5 (8.0)	75/63	32.3	28.5	39.3	2.19	14.8		3.6 (8.3)	60	50.5	44.0	1.98	7.5
			80/67	34.9	29.6	41.7	2.16	16.2			70	48.9	41.5	2.26	6.3
			85/71	37.5	30.7	44.3	2.12	17.7			80	47.4	38.9	2.56	5.4
100	6	1.0 (2.2)	75/63	28.8	27.0	37.1	2.64	10.9	Operation Not Recommended						
			80/67	31.0	28.3	39.3	2.63	11.8							
			85/71	33.3	29.4	41.6	2.61	12.7							
	8	1.6 (3.8)	75/63	29.4	27.3	37.4	2.56	11.5							
			80/67	31.6	28.5	39.7	2.54	12.4							
			85/71	34.0	29.7	42.0	2.52	13.5							
	12	3.4 (7.8)	75/63	30.0	27.6	37.8	2.48	12.1							
			80/67	32.4	28.7	40.2	2.45	13.2							
			85/71	34.8	29.9	42.5	2.42	14.4							
110	6	1.0 (2.2)	75/63	26.6	26.2	35.9	2.96	9.0							
			80/67	28.7	27.4	38.0	2.95	9.7							
			85/71	30.5	28.5	39.9	2.94	10.4							
	8	1.6 (3.6)	75/63	27.1	26.4	36.1	2.88	9.4							
			80/67	29.3	27.7	38.3	2.86	10.2							
			85/71	31.5	28.8	40.5	2.84	11.1							
	12	3.3 (7.6)	75/63	27.7	26.6	36.5	2.80	9.9							
			80/67	29.9	27.9	38.7	2.77	10.8							
			85/71	32.2	29.1	41.0	2.74	11.7							

Performance data (cont)

Carrier
United Technologies

50PTH,PTV048

1,600 CFM AT 0.60-in. ESP — FULL LOAD

COOLING									HEATING						
Entering Fluid Temp (F)	Water Flow (GPM)	Pressure Drop PSI (FOH)	Entering Air Temp (db/wb) F	Total Capacity (MBtuh)	Sensible Capacity (MBtuh)	Heat of Rejection (MBtuh)	Power Input (kW)	EER	Entering Fluid Temp (F)	Pressure Drop PSI (FOH)	Entering Air Temp (F)	Total Capacity (MBtuh)	Heat of Absorption (MBtuh)	Power Input (kW)	COP
50	6	1.1 (2.6)	75/63	52.4	40.1	60.5	2.47	21.2	30	1.2 (2.8)	60	34.5	25.7	2.67	3.8
			80/67	55.8	41.4	64.0	2.50	22.3			70	34.0	24.2	2.98	3.3
			85/71	59.4	42.3	67.7	2.53	23.5			80	34.2	22.4	3.32	3.0
	8	1.9 (4.4)	75/63	53.7	40.7	61.4	2.36	22.8		2.0 (4.7)	60	35.8	26.9	2.70	3.9
			80/67	57.2	41.9	65.0	2.38	24.1			70	35.4	25.1	3.01	3.4
			85/71	61.0	42.9	68.9	2.40	25.5			80	34.9	23.4	3.34	3.1
	12	3.9 (9.1)	75/63	55.0	41.3	62.4	2.24	24.6		4.2 (9.8)	60	37.3	28.2	2.73	4.0
			80/67	58.8	42.4	66.3	2.25	26.1			70	36.7	26.3	3.04	3.5
			85/71	62.7	43.6	70.2	2.26	27.7			80	36.6	24.3	3.37	3.2
60	6	1.1 (2.5)	75/63	50.0	39.2	58.8	2.69	18.6	40	1.2 (2.7)	60	39.5	30.3	2.79	4.2
			80/67	53.4	40.4	62.2	2.71	19.7			70	38.8	28.6	3.09	3.7
			85/71	56.9	41.4	65.9	2.74	20.8			80	39.0	26.6	3.42	3.3
	8	1.9 (4.3)	75/63	51.3	39.7	59.6	2.57	20.0		2.0 (4.6)	60	41.5	31.4	2.82	4.3
			80/67	54.8	40.8	63.3	2.59	21.2			70	40.3	30.0	3.12	3.8
			85/71	58.4	42.0	67.0	2.61	22.4			80	40.3	27.8	3.45	3.4
	12	3.8 (8.8)	75/63	52.6	40.3	60.6	2.45	21.5		4.1 (9.5)	60	42.9	33.3	2.86	4.4
			80/67	56.3	41.4	64.4	2.46	22.9			70	42.0	31.4	3.15	3.9
			85/71	59.9	42.7	68.1	2.47	24.2			80	41.1	29.4	3.48	3.5
70	6	1.1 (2.5)	75/63	47.7	38.2	57.1	2.93	16.3	50	1.1 (2.6)	60	44.9	35.0	2.90	4.5
			80/67	50.9	39.4	60.5	2.95	17.2			70	44.7	33.1	3.20	4.1
			85/71	54.3	40.4	64.0	2.98	18.2			80	44.0	31.3	3.52	3.7
	8	1.8 (4.1)	75/63	48.9	38.6	58.0	2.81	17.4		1.9 (4.4)	60	47.3	36.7	2.94	4.7
			80/67	52.2	39.9	61.5	2.83	18.5			70	46.4	34.7	3.23	4.2
			85/71	55.6	41.1	64.9	2.84	19.6			80	45.7	32.7	3.56	3.8
	12	3.7 (8.6)	75/63	50.1	39.1	58.9	2.68	18.7		4.0 (9.1)	60	49.0	39.0	2.98	4.8
			80/67	53.6	40.5	62.4	2.69	19.9			70	47.9	36.7	3.27	4.3
			85/71	57.2	41.7	66.1	2.70	21.2			80	47.5	34.3	3.60	3.9
80	6	1.0 (2.4)	75/63	45.2	37.1	55.5	3.20	14.1	60	1.1 (2.5)	60	50.6	40.4	3.01	4.9
			80/67	48.3	38.4	58.8	3.23	14.9			70	49.6	38.4	3.31	4.4
			85/71	51.6	39.5	62.2	3.26	15.8			80	48.8	36.4	3.64	3.9
	8	1.7 (4.0)	75/63	46.4	37.5	56.3	3.07	15.1		1.8 (4.3)	60	53.4	42.4	3.05	5.1
			80/67	49.6	38.8	59.7	3.09	16.0			70	52.3	40.2	3.35	4.6
			85/71	53.0	40.0	63.1	3.11	17.0			80	51.3	37.9	3.68	4.1
	12	3.6 (8.3)	75/63	47.5	38.1	57.0	2.94	16.1		3.8 (8.8)	60	55.4	45.0	3.09	5.2
			80/67	50.9	39.4	60.5	2.95	17.2			70	54.0	42.6	3.39	4.7
			85/71	54.4	40.6	64.1	2.96	18.4			80	52.8	40.1	3.73	4.1
85	6	1.0 (2.3)	75/63	44.0	36.5	54.8	3.35	13.1	70	1.1 (2.5)	60	56.5	46.0	3.11	5.3
			80/67	47.0	37.9	57.9	3.38	13.9			70	55.4	43.8	3.42	4.7
			85/71	50.2	39.0	61.3	3.42	14.7			80	54.5	41.6	3.77	4.2
	8	1.7 (3.9)	75/63	45.1	37.1	55.4	3.22	14.0		1.8 (4.1)	60	59.1	48.4	3.16	5.5
			80/67	48.2	38.4	58.7	3.24	14.9			70	57.8	46.0	3.47	4.9
			85/71	51.6	39.5	62.2	3.26	15.8			80	58.4	42.8	3.82	4.5
	12	3.5 (8.1)	75/63	46.3	37.5	56.3	3.09	15.0		3.7 (8.6)	60	62.1	51.4	3.21	5.7
			80/67	49.6	38.8	59.6	3.10	16.0			70	60.5	48.7	3.52	5.0
			85/71	53.0	40.0	63.2	3.11	17.0			80	59.1	46.0	3.88	4.5
90	6	1.0 (2.3)	75/63	42.7	36.1	54.0	3.52	12.1	80	1.0 (2.4)	60	62.6	52.1	3.22	5.7
			80/67	45.7	37.4	57.1	3.55	12.9			70	61.4	49.5	3.54	5.1
			85/71	48.8	38.5	60.4	3.59	13.6			80	60.2	47.0	3.90	4.5
	8	1.7 (3.9)	75/63	43.8	36.4	54.7	3.38	13.0		1.7 (4.0)	60	65.6	55.0	3.27	5.9
			80/67	46.8	37.9	57.8	3.40	13.8			70	64.1	52.0	3.59	5.2
			85/71	50.1	39.0	61.3	3.43	14.6			80	62.8	49.3	3.96	4.6
	12	3.5 (8.0)	75/63	44.9	37.0	55.3	3.24	13.9		3.6 (8.3)	60	69.0	58.0	3.33	6.1
			80/67	48.2	38.3	58.7	3.25	14.8			70	67.2	54.9	3.66	5.4
			85/71	51.6	39.5	62.2	3.27	15.8			80	65.8	51.4	4.03	4.8
100	6	1.0 (2.2)	75/63	40.2	35.1	52.7	3.88	10.4	Operation Not Recommended						
			80/67	43.1	36.3	55.7	3.92	11.0							
			85/71	45.9	37.7	58.7	3.96	11.6							
	8	1.6 (3.8)	75/63	41.2	35.5	53.2	3.73	11.0							
			80/67	44.2	36.7	56.3	3.76	11.8							
			85/71	47.2	38.0	59.5	3.79	12.5							
	12	3.4 (7.8)	75/63	42.2	35.9	53.7	3.59	11.8							
			80/67	45.3	37.3	56.9	3.60	12.6							
			85/71	48.6	38.4	60.3	3.62	13.4							
110	6	1.0 (2.2)	75/63	37.6	34.0	51.4	4.31	8.7							
			80/67	40.3	35.3	54.3	4.35	9.3							
			85/71	42.9	36.7	57.1	4.40	9.8							
	8	1.6 (3.6)	75/63	38.5	34.4	51.8	4.15	9.3							
			80/67	41.3	35.8	54.7	4.17	9.9							
			85/71	44.1	37.1	57.7	4.21	10.5							
	12	3.3 (7.6)	75/63	39.5	34.8	52.3	3.99	9.9							
			80/67	42.5	36.1	55.4	4.01	10.6							
			85/71	45.4	37.5	58.4	4.02	11.3							

See Legend and Notes on page 16.

50PTH,PTV060

1,600 CFM AT 0.60-in. ESP — PART LOAD

COOLING									HEATING						
Entering Fluid Temp (F)	Water Flow (GPM)	Pressure Drop PSI (FOH)	Entering Air Temp (db/wb) F	Total Capacity (MBtuh)	Sensible Capacity (MBtuh)	Heat of Rejection (MBtuh)	Power Input (kW)	EER	Entering Fluid Temp (F)	Pressure Drop PSI (FOH)	Entering Air Temp (F)	Total Capacity (MBtuh)	Heat of Absorption (MBtuh)	Power Input (kW)	COP
50	7.5	1.2 (2.8)	75/63	51.0	39.7	57.1	1.85	27.5	30	1.3 (3.0)	60	33.6	25.2	2.56	3.8
			80/67	54.5	40.9	60.5	1.83	29.8			70	32.4	22.8	2.85	3.3
			85/71	58.0	42.1	63.9	1.79	32.3			80	31.2	20.6	3.17	2.9
	10.0	2.0 (4.7)	75/63	52.1	40.2	57.9	1.77	29.4		2.2 (5.0)	60	34.5	26.0	2.57	3.9
			80/67	55.7	41.4	61.4	1.74	32.0			70	33.1	23.8	2.86	3.4
			85/71	59.3	42.5	64.9	1.70	34.8			80	31.9	21.4	3.18	2.9
	15.0	4.2 (9.7)	75/63	53.2	40.6	58.8	1.69	31.4		4.5 (10.4)	60	35.5	27.0	2.57	4.0
			80/67	56.8	41.9	62.3	1.65	34.3			70	34.4	24.3	2.87	3.5
			85/71	60.7	42.9	66.1	1.61	37.7			80	32.7	22.2	3.19	3.0
60	7.5	1.1 (2.6)	75/63	48.3	38.5	55.0	2.08	23.2	40	1.3 (2.9)	60	38.4	29.8	2.59	4.3
			80/67	51.7	39.7	58.4	2.05	25.2			70	37.1	27.5	2.89	3.8
			85/71	55.1	40.9	61.8	2.02	27.2			80	35.8	25.2	3.22	3.3
	10.0	1.9 (4.4)	75/63	49.3	38.9	55.8	2.00	24.7		2.1 (4.9)	60	39.5	31.0	2.60	4.5
			80/67	52.8	40.2	59.2	1.96	26.9			70	38.1	28.6	2.90	3.9
			85/71	56.2	41.4	62.6	1.93	29.2			80	36.7	26.2	3.23	3.3
	15.0	3.9 (9.1)	75/63	50.4	39.3	56.6	1.91	26.4		4.4 (10.9)	60	40.8	32.2	2.61	4.6
			80/67	53.8	40.7	60.0	1.87	28.8			70	39.2	29.6	2.91	4.0
			85/71	57.6	41.8	63.7	1.83	31.5			80	38.0	27.0	3.24	3.4
70	7.5	1.1 (2.6)	75/63	45.5	37.3	53.1	2.34	19.4	50	1.2 (2.8)	60	43.6	34.9	2.62	4.9
			80/67	48.6	38.7	56.2	2.31	21.0			70	42.2	32.4	2.93	4.2
			85/71	52.1	39.8	59.5	2.29	22.8			80	41.0	29.9	3.26	3.7
	10.0	1.9 (4.4)	75/63	46.4	37.8	53.7	2.25	20.6		2.0 (4.7)	60	45.0	36.3	2.63	5.0
			80/67	49.8	39.0	57.0	2.22	22.4			70	43.5	33.6	2.93	4.3
			85/71	53.2	40.2	60.4	2.18	24.4			80	42.0	31.3	3.27	3.8
	15.0	3.9 (9.1)	75/63	47.4	38.2	54.4	2.16	21.9		4.2 (9.7)	60	46.5	38.0	2.63	5.2
			80/67	50.8	39.5	57.7	2.12	23.9			70	45.4	34.8	2.94	4.5
			85/71	54.3	40.8	61.2	2.08	26.1			80	43.4	32.1	3.28	3.9
80	7.5	1.1 (2.5)	75/63	42.6	36.1	51.1	2.64	16.1	60	1.2 (2.7)	60	49.1	40.4	2.64	5.5
			80/67	45.7	37.5	54.2	2.61	17.5			70	47.6	37.8	2.96	4.7
			85/71	48.9	38.8	57.2	2.58	18.9			80	46.3	35.0	3.30	4.1
	10.0	1.8 (4.2)	75/63	43.5	36.4	51.7	2.55	17.1		2.0 (4.5)	60	51.2	41.8	2.64	5.7
			80/67	46.7	37.8	54.8	2.51	18.6			70	49.6	39.0	2.96	4.9
			85/71	49.9	39.2	58.0	2.47	20.2			80	47.7	36.3	3.31	4.2
	15.0	3.8 (8.8)	75/63	44.3	36.9	52.2	2.45	18.1		4.1 (9.4)	60	52.6	44.1	2.65	5.8
			80/67	47.7	38.3	55.5	2.41	19.8			70	51.3	40.6	2.97	5.1
			85/71	51.2	39.5	58.9	2.37	21.6			80	49.1	38.4	3.32	4.3
85	7.5	1.1 (2.5)	75/63	41.1	35.6	50.1	2.80	14.7	70	1.1 (2.6)	60	55.4	45.9	2.65	6.1
			80/67	44.2	36.9	53.2	2.77	15.9			70	53.8	43.1	2.98	5.3
			85/71	47.4	38.2	56.3	2.75	17.3			80	51.7	40.7	3.34	4.5
	10.0	1.8 (4.2)	75/63	42.0	35.9	50.6	2.71	15.5		1.9 (4.4)	60	57.3	47.8	2.66	6.3
			80/67	45.2	37.2	53.8	2.67	16.9			70	55.5	44.9	2.99	5.5
			85/71	48.4	38.5	57.0	2.64	18.3			80	53.5	41.8	3.35	4.7
	15.0	3.7 (8.5)	75/63	42.9	36.2	51.3	2.61	16.4		3.9 (9.1)	60	59.5	49.9	2.66	6.6
			80/67	46.1	37.6	54.4	2.57	17.9			70	57.5	46.7	2.99	5.6
			85/71	49.5	38.9	57.7	2.53	19.6			80	55.7	43.5	3.36	4.9
90	7.5	1.0 (2.4)	75/63	39.7	35.0	49.2	2.97	13.4	80	1.1 (2.5)	60	61.3	51.9	2.66	6.8
			80/67	42.7	36.3	52.2	2.94	14.5			70	59.6	48.9	3.00	5.8
			85/71	45.8	37.6	55.2	2.92	15.7			80	57.4	46.2	3.37	5.0
	10.0	1.8 (4.1)	75/63	40.5	35.2	49.7	2.88	14.1		1.8 (4.2)	60	63.6	54.1	2.66	7.0
			80/67	43.6	36.7	52.7	2.84	15.3			70	61.1	51.3	3.00	6.0
			85/71	46.8	38.1	55.8	2.81	16.7			80	59.4	47.6	3.38	5.2
	15.0	3.7 (8.5)	75/63	41.4	35.5	50.3	2.78	14.9		3.8 (8.8)	60	66.0	56.5	2.66	7.3
			80/67	44.5	37.0	53.4	2.74	16.2			70	63.8	53.0	3.01	6.2
			85/71	47.8	38.5	56.5	2.70	17.7			80	61.8	49.6	3.38	5.4
100	7.5	1.0 (2.4)	75/63	36.9	33.8	47.5	3.32	11.1	Operation Not Recommended						
			80/67	39.7	35.3	50.3	3.30	12.0							
			85/71	42.6	36.6	53.2	3.29	13.0							
	10.0	1.7 (4.0)	75/63	37.6	34.1	47.9	3.23	11.6							
			80/67	40.5	35.6	50.7	3.21	12.6							
			85/71	43.4	37.0	53.7	3.18	13.6							
	15.0	3.6 (8.3)	75/63	38.4	34.3	48.4	3.14	12.2							
			80/67	41.3	35.9	51.2	3.11	13.3							
			85/71	44.5	37.2	54.4	3.07	14.5							
110	7.5	1.0 (2.3)	75/63	34.0	32.7	45.8	3.72	9.1							
			80/67	36.6	34.2	48.5	3.71	9.9							
			85/71	39.4	35.7	51.3	3.68	10.7							
	10.0	1.7 (3.9)	75/63	34.6	33.0	46.1	3.63	9.5							
			80/67	37.4	34.5	48.9	3.60	10.4							
			85/71	40.3	35.9	51.8	3.58	11.3							
	15.0	3.5 (8.0)	75/63	35.3	33.2	46.5	3.54	10.0							
			80/67	38.2	34.6	49.4	3.50	10.9							
			85/71	41.1	36.2	52.2	3.47	11.8							

Performance data (cont)

Carrier
United Technologies

50PTH,PTV060
2,000 CFM AT 0.60-in. ESP — FULL LOAD

COOLING									HEATING						
Entering Fluid Temp (F)	Water Flow (GPM)	Pressure Drop PSI (FOH)	Entering Air Temp (db/wb) F	Total Capacity (MBtuh)	Sensible Capacity (MBtuh)	Heat of Rejection (MBtuh)	Power Input (kW)	EER	Entering Fluid Temp (F)	Pressure Drop PSI (FOH)	Entering Air Temp (F)	Total Capacity (MBtuh)	Heat of Absorption (MBtuh)	Power Input (kW)	COP
50	7.5	1.2 (2.8)	75/63	66.6	50.5	77.1	3.15	21.1	30	1.3 (3.0)	60	46.3	33.6	3.51	3.9
			80/67	71.0	52.0	81.7	3.21	22.1			70	45.8	31.6	3.87	3.5
			85/71	75.5	53.4	86.4	3.27	23.1			80	45.2	29.7	4.25	3.1
	10.0	2.0 (4.7)	75/63	68.0	51.1	78.1	3.04	22.4		2.2 (5.0)	60	47.3	35.4	3.54	3.9
			80/67	72.5	52.7	82.8	3.09	23.4			70	47.2	32.8	3.90	3.6
			85/71	77.3	54.1	87.8	3.15	24.5			80	45.8	31.2	4.28	3.1
	15.0	4.2 (9.7)	75/63	69.5	51.8	79.2	2.93	23.7		4.5 (10.4)	60	49.1	36.7	3.57	4.0
			80/67	74.1	53.3	84.1	2.98	24.9			70	48.0	34.8	3.93	3.6
			85/71	79.2	54.6	89.4	3.04	26.1			80	48.0	31.9	4.31	3.3
60	7.5	1.1 (2.6)	75/63	63.9	49.4	75.1	3.40	18.8	40	1.3 (2.9)	60	52.6	39.2	3.63	4.2
			80/67	68.1	51.0	79.4	3.45	19.8			70	52.9	36.5	3.99	3.9
			85/71	72.4	52.3	84.0	3.50	20.7			80	52.2	34.5	4.38	3.5
	10.0	1.9 (4.4)	75/63	65.3	50.0	76.1	3.27	19.9		2.1 (4.9)	60	54.5	40.9	3.67	4.4
			80/67	69.6	51.6	80.6	3.32	21.0			70	53.6	38.7	4.02	3.9
			85/71	74.3	52.8	85.5	3.37	22.0			80	52.8	36.5	4.42	3.5
	15.0	3.9 (9.1)	75/63	66.6	50.6	77.0	3.15	21.1		4.4 (10.9)	60	56.0	43.2	3.71	4.4
			80/67	71.3	52.0	81.9	3.20	22.3			70	54.8	40.8	4.06	4.0
			85/71	76.0	53.5	86.8	3.24	23.4			80	54.6	38.0	4.46	3.6
70	7.5	1.1 (2.6)	75/63	61.0	48.2	73.0	3.67	16.6	50	1.2 (2.8)	60	58.8	45.8	3.76	4.6
			80/67	65.1	49.8	77.3	3.72	17.5			70	57.8	43.5	4.12	4.1
			85/71	69.3	51.2	81.7	3.78	18.4			80	56.9	41.2	4.52	3.7
	10.0	1.9 (4.4)	75/63	62.3	48.8	73.9	3.54	17.6		2.0 (4.7)	60	61.0	48.5	3.81	4.7
			80/67	66.6	50.4	78.4	3.58	18.6			70	60.6	45.2	4.17	4.3
			85/71	71.1	51.6	83.1	3.63	19.6			80	59.6	42.7	4.57	3.8
	15.0	3.9 (9.1)	75/63	63.7	49.2	75.0	3.42	18.6		4.2 (9.7)	60	63.6	50.5	3.86	4.8
			80/67	68.1	50.8	79.5	3.45	19.7			70	63.1	47.2	4.22	4.4
			85/71	72.6	52.4	84.2	3.49	20.8			80	61.8	44.5	4.62	3.9
80	7.5	1.1 (2.5)	75/63	58.1	47.0	71.1	4.00	14.5	60	1.2 (2.7)	60	67.6	51.7	3.90	5.1
			80/67	62.1	48.4	75.4	4.05	15.3			70	66.5	49.2	4.27	4.6
			85/71	66.0	50.0	79.5	4.10	16.1			80	63.7	48.1	4.69	4.0
	10.0	1.8 (4.2)	75/63	59.3	47.5	71.9	3.86	15.4		2.0 (4.5)	60	69.4	54.8	3.96	5.1
			80/67	63.4	49.1	76.2	3.89	16.3			70	68.0	52.1	4.33	4.6
			85/71	67.6	50.6	80.6	3.93	17.2			80	68.0	48.2	4.74	4.2
	15.0	3.8 (8.8)	75/63	60.7	47.9	72.9	3.72	16.3		4.1 (9.4)	60	71.8	58.1	4.02	5.2
			80/67	64.9	49.5	77.3	3.75	17.3			70	70.1	55.1	4.39	4.7
			85/71	69.3	51.0	81.8	3.78	18.3			80	69.5	51.5	4.80	4.2
85	7.5	1.1 (2.5)	75/63	56.6	46.4	70.2	4.18	13.5	70	1.1 (2.6)	60	74.2	59.4	4.06	5.4
			80/67	60.5	47.8	74.4	4.23	14.3			70	72.8	56.6	4.43	4.8
			85/71	64.4	49.4	78.4	4.27	15.1			80	71.6	53.8	4.85	4.3
	10.0	1.8 (4.2)	75/63	57.9	46.8	71.1	4.04	14.3		1.9 (4.4)	60	77.5	62.3	4.12	5.5
			80/67	61.8	48.5	75.1	4.07	15.2			70	77.0	58.1	4.50	5.0
			85/71	66.0	49.8	79.6	4.11	16.1			80	75.6	55.0	4.92	4.5
	15.0	3.7 (8.5)	75/63	59.0	47.4	71.7	3.89	15.1		3.9 (9.1)	60	80.4	66.2	4.20	5.6
			80/67	63.1	49.0	76.0	3.92	16.1			70	78.4	62.7	4.58	5.0
			85/71	67.6	50.4	80.6	3.95	17.1			80	76.8	59.4	5.00	4.5
90	7.5	1.0 (2.4)	75/63	55.1	45.7	69.3	4.37	12.6	80	1.1 (2.5)	60	82.1	66.8	4.22	5.7
			80/67	58.9	47.4	73.3	4.42	13.3			70	80.5	63.7	4.61	5.1
			85/71	62.7	48.8	77.3	4.47	14.0			80	79.0	60.5	5.04	4.6
	10.0	1.8 (4.1)	75/63	56.3	46.1	70.1	4.23	13.3		1.8 (4.2)	60	85.9	70.1	4.31	5.8
			80/67	60.1	47.9	74.1	4.26	14.1			70	84.0	66.7	4.69	5.3
			85/71	64.3	49.2	78.4	4.30	15.0			80	82.2	63.3	5.12	4.7
	15.0	3.7 (8.5)	75/63	57.4	46.7	70.7	4.08	14.1		3.8 (8.8)	60	89.3	74.5	4.40	5.9
			80/67	61.5	48.4	74.9	4.10	15.0			70	87.1	71.6	4.79	5.3
			85/71	65.7	49.9	79.3	4.13	15.9			80	85.7	66.2	5.22	4.8
100	7.5	1.0 (2.4)	75/63	52.0	44.5	67.6	4.80	10.8	Operation Not Recommended						
			80/67	55.6	46.1	71.4	4.85	11.5							
			85/71	59.2	47.6	75.2	4.89	12.1							
	10.0	1.7 (4.0)	75/63	53.1	44.9	68.2	4.65	11.4							
			80/67	56.8	46.6	72.1	4.68	12.1							
			85/71	60.7	48.0	76.2	4.72	12.9							
	15.0	3.6 (8.3)	75/63	54.2	45.4	68.8	4.50	12.0							
			80/67	58.0	47.1	72.8	4.52	12.8							
			85/71	62.2	48.4	77.1	4.55	13.7							
110	7.5	1.0 (2.3)	75/63	48.9	43.2	66.1	5.30	9.2							
			80/67	52.2	44.9	69.6	5.34	9.8							
			85/71	55.6	46.4	73.2	5.39	10.3							
	10.0	1.7 (3.9)	75/63	49.9	43.6	66.5	5.13	9.7							
			80/67	53.4	45.3	70.2	5.17	10.3							
			85/71	57.0	46.9	74.0	5.20	11.0							
	15.0	3.5 (8.0)	75/63	50.9	43.8	67.2	4.99	10.2							
			80/67	54.5	45.7	70.8	5.00	10.9							
			85/71	58.3	47.3	74.7	5.02	11.6							

See Legend and Notes on page 16.

50PTH,PTV070

1,850 CFM AT 0.60-in. ESP — PART LOAD

COOLING									HEATING						
Entering Fluid Temp (F)	Water Flow (GPM)	Pressure Drop PSI (FOH)	Entering Air Temp (db/wb) F	Total Capacity (MBtuh)	Sensible Capacity (MBtuh)	Heat of Rejection (MBtuh)	Power Input (kW)	EER	Entering Fluid Temp (F)	Pressure Drop PSI (FOH)	Entering Air Temp (F)	Total Capacity (MBtuh)	Heat of Absorption (MBtuh)	Power Input (kW)	COP
50	9	0.9 (2.1)	75/63	58.8	45.7	66.3	2.28	25.7	30	1.0 (2.3)	60	39.9	29.3	3.05	3.8
			80/67	62.6	47.1	70.1	2.27	27.5			70	39.5	26.9	3.39	3.4
			85/71	66.6	48.4	74.1	2.27	29.4			80	38.8	25.8	3.78	3.0
	12	1.5 (3.5)	75/63	59.9	46.2	67.1	2.18	27.5		1.6 (3.8)	60	41.5	25.9	3.05	4.0
			80/67	63.9	47.7	71.0	2.16	29.5			70	40.3	29.6	3.40	3.5
			85/71	68.2	48.8	75.3	2.15	31.8			80	39.3	23.9	3.78	3.0
	18	3.2 (7.3)	75/63	61.1	46.7	68.0	2.07	29.4		3.4 (7.9)	60	41.7	33.0	3.07	4.0
			80/67	65.3	48.1	72.1	2.05	31.9			70	41.1	29.1	3.41	3.5
			85/71	69.6	49.4	76.4	2.02	34.4			80	40.0	27.3	3.80	3.1
60	9	0.9 (2.0)	75/63	56.0	44.6	64.3	2.54	22.0	40	0.9 (2.2)	60	45.1	35.0	3.09	4.3
			80/67	59.7	46.0	68.1	2.54	23.5			70	45.4	23.5	3.41	3.9
			85/71	63.6	47.4	72.0	2.54	25.0			80	41.0	36.0	3.82	3.1
	12	1.5 (3.4)	75/63	57.1	45.0	65.1	2.43	23.4		1.6 (3.7)	60	46.8	36.0	3.10	4.4
			80/67	61.1	46.4	69.0	2.42	25.2			70	46.3	27.9	3.44	4.0
			85/71	65.1	47.7	73.1	2.41	27.0			80	45.2	29.5	3.84	3.5
	18	3.1 (7.1)	75/63	58.3	45.5	65.9	2.33	25.1		3.3 (7.6)	60	49.2	32.8	3.11	4.6
			80/67	62.3	47.0	69.9	2.30	27.0			70	46.4	35.5	3.46	3.9
			85/71	66.4	48.4	74.0	2.28	29.1			80	46.3	32.4	3.85	3.5
70	9	0.9 (2.0)	75/63	53.2	43.4	62.4	2.84	18.7	50	0.9 (2.1)	60	51.3	41.1	3.13	4.8
			80/67	56.8	44.9	66.1	2.84	20.0			70	50.1	38.8	3.49	4.2
			85/71	60.7	46.1	70.0	2.85	21.3			80	50.1	36.3	3.89	3.8
	12	1.4 (3.3)	75/63	54.3	43.7	63.2	2.73	19.9		1.5 (3.5)	60	53.3	42.5	3.14	5.0
			80/67	58.1	45.2	67.0	2.72	21.3			70	53.6	29.9	3.48	4.5
			85/71	62.0	46.6	70.9	2.71	22.8			80	52.0	29.2	3.88	3.9
	18	3.0 (6.9)	75/63	55.4	44.2	63.9	2.61	21.2		3.2 (7.3)	60	56.6	36.6	3.14	5.3
			80/67	59.2	45.8	67.7	2.60	22.8			70	54.9	35.8	3.51	4.6
			85/71	63.2	47.2	71.7	2.58	24.5			80	51.4	40.1	3.92	3.8
80	9	0.8 (1.9)	75/63	50.4	42.1	60.7	3.18	15.8	60	0.9 (2.0)	60	58.2	47.3	3.17	5.4
			80/67	53.8	43.7	64.1	3.18	16.9			70	56.8	44.6	3.54	4.7
			85/71	57.4	45.1	67.8	3.19	18.0			80	55.8	41.9	3.95	4.1
	12	1.4 (3.2)	75/63	51.3	42.6	61.2	3.06	16.8		1.5 (3.4)	60	60.4	49.3	3.19	5.6
			80/67	54.9	44.2	64.8	3.06	18.0			70	59.1	46.8	3.56	4.9
			85/71	58.6	45.6	68.6	3.05	19.2			80	53.4	55.4	3.97	3.9
	18	2.9 (6.6)	75/63	52.4	43.0	61.9	2.94	17.8		3.1 (7.1)	60	64.5	36.4	3.17	6.0
			80/67	56.1	44.5	65.7	2.93	19.2			70	62.5	39.4	3.56	5.1
			85/71	59.9	46.0	69.4	2.91	20.6			80	59.8	40.5	3.98	4.4
85	9	0.8 (1.9)	75/63	48.9	41.5	59.8	3.37	14.5	70	0.9 (2.0)	60	65.2	54.3	3.22	5.9
			80/67	52.2	43.1	63.2	3.37	15.5			70	63.7	51.4	3.61	5.2
			85/71	55.9	44.4	66.9	3.38	16.5			80	63.7	49.9	4.05	4.6
	12	1.3 (3.1)	75/63	49.9	41.9	60.3	3.24	15.4		1.4 (3.3)	60	67.6	57.3	3.24	6.1
			80/67	53.3	43.6	63.8	3.24	16.4			70	66.5	53.6	3.63	5.4
			85/71	57.1	44.9	67.6	3.24	17.6			80	65.9	51.7	4.07	4.7
	18	2.8 (6.5)	75/63	50.8	42.4	60.9	3.12	16.3		3.0 (6.9)	60	73.6	39.7	3.21	6.7
			80/67	54.5	43.9	64.6	3.11	17.5			70	70.6	41.8	3.62	5.7
			85/71	58.2	45.4	68.3	3.10	18.8			80	64.7	64.5	4.09	4.6
90	9	0.8 (1.8)	75/63	47.5	40.9	58.9	3.56	13.3	80	0.8 (1.9)	60	72.6	61.5	3.27	6.5
			80/67	50.7	42.6	62.2	3.57	14.2			70	70.9	58.1	3.67	5.7
			85/71	54.2	44.0	65.8	3.58	15.1			80	69.3	55.1	4.11	4.9
	12	1.3 (3.1)	75/63	48.3	41.4	59.4	3.44	14.0		1.4 (3.2)	60	75.6	64.2	3.29	6.7
			80/67	51.8	42.8	62.9	3.44	15.1			70	73.7	60.7	3.70	5.8
			85/71	55.4	44.3	66.6	3.44	16.1			80	60.8	93.6	4.14	4.3
	18	2.8 (6.4)	75/63	49.3	41.7	60.0	3.31	14.9		2.9 (6.6)	60	79.3	67.6	3.32	7.0
			80/67	52.9	43.3	63.6	3.30	16.0			70	77.5	63.6	3.73	6.1
			85/71	56.5	44.8	67.2	3.29	17.2			80	77.0	40.6	4.11	5.5
100	9	0.8 (1.8)	75/63	44.4	39.7	57.3	3.99	11.1	Operation Not Recommended						
			80/67	47.6	41.4	60.5	4.00	11.9							
			85/71	51.0	43.0	63.9	3.99	12.8							
	12	1.3 (3.0)	75/63	45.3	40.1	57.7	3.87	11.7							
			80/67	48.6	41.6	61.1	3.87	12.6							
			85/71	52.0	43.3	64.5	3.85	13.5							
	18	2.7 (6.2)	75/63	46.1	40.5	58.1	3.74	12.3							
			80/67	49.5	42.1	61.5	3.73	13.3							
			85/71	53.1	43.7	65.1	3.71	14.3							
110	9	0.7 (1.7)	75/63	41.2	38.6	55.6	4.47	9.2							
			80/67	44.5	40.3	58.9	4.46	10.0							
			85/71	47.7	41.9	62.1	4.45	10.7							
	12	1.3 (2.9)	75/63	42.2	38.8	56.2	4.35	9.7							
			80/67	45.4	40.6	59.4	4.33	10.5							
			85/71	48.8	42.2	62.7	4.31	11.3							
	18	2.6 (6.1)	75/63	42.9	39.2	56.5	4.22	10.2							
			80/67	46.2	40.9	59.8	4.19	11.0							
			85/71	49.8	42.5	63.3	4.17	11.9							

Performance data (cont)

50PTH,PTV070

2,350 CFM AT 0.60-in. ESP — FULL LOAD

COOLING									HEATING						
Entering Fluid Temp (F)	Water Flow (GPM)	Pressure Drop PSI (FOH)	Entering Air Temp (db/wb) F	Total Capacity (MBtuh)	Sensible Capacity (MBtuh)	Heat of Rejection (MBtuh)	Power Input (kW)	EER	Entering Fluid Temp (F)	Pressure Drop PSI (FOH)	Entering Air Temp (F)	Total Capacity (MBtuh)	Heat of Absorption (MBtuh)	Power Input (kW)	COP
50	9	0.9 (2.1)	75/63	74.5	56.1	86.7	3.68	20.2	30	1.0 (2.3)	60	52.5	38.1	4.16	3.7
			80/67	79.5	58.0	91.9	3.73	21.3			70	51.6	35.9	4.56	3.3
			85/71	84.7	59.6	97.3	3.79	22.4			80	51.9	33.7	4.99	3.0
	12	1.5 (3.5)	75/63	76.2	56.8	87.9	3.53	21.6		1.6 (3.8)	60	54.0	39.4	4.20	3.8
			80/67	81.5	58.4	93.4	3.57	22.8			70	54.0	37.3	4.59	3.4
			85/71	86.8	60.4	98.9	3.62	24.0			80	52.9	34.2	5.02	3.1
	18	3.2 (7.3)	75/63	78.0	57.6	89.2	3.37	23.1		3.4 (7.9)	60	55.8	41.6	4.23	3.9
			80/67	83.5	59.2	94.9	3.41	24.5			70	55.3	38.1	4.63	3.5
			85/71	89.2	60.9	100.8	3.45	25.9			80	54.4	37.2	5.07	3.1
60	9	0.9 (2.0)	75/63	71.4	54.9	84.5	3.98	18.0	40	0.9 (2.2)	60	59.7	44.6	4.29	4.1
			80/67	76.4	56.4	89.7	4.03	19.0			70	59.0	42.5	4.70	3.7
			85/71	81.5	58.0	95.0	4.07	20.0			80	57.8	40.1	5.14	3.3
	12	1.5 (3.4)	75/63	73.0	55.6	85.6	3.82	19.1		1.6 (3.7)	60	61.6	46.5	4.33	4.2
			80/67	78.1	57.4	90.8	3.86	20.2			70	60.7	44.3	4.74	3.8
			85/71	83.3	59.1	96.3	3.90	21.4			80	59.8	42.1	5.19	3.4
	18	3.1 (7.1)	75/63	74.8	56.0	86.9	3.67	20.4		3.3 (7.6)	60	64.2	49.1	4.38	4.3
			80/67	80.1	57.8	92.4	3.69	21.7			70	63.0	47.1	4.79	3.9
			85/71	85.6	59.5	98.1	3.73	23.0			80	61.5	43.6	5.23	3.4
70	9	0.9 (2.0)	75/63	68.3	53.3	82.5	4.31	15.9	50	0.9 (2.1)	60	67.2	52.0	4.43	4.4
			80/67	72.9	55.4	87.2	4.34	16.8			70	66.4	49.8	4.85	4.0
			85/71	77.8	57.1	92.3	4.39	17.7			80	65.8	47.6	5.31	3.6
	12	1.4 (3.3)	75/63	69.7	54.2	83.4	4.14	16.8		1.5 (3.5)	60	70.4	54.6	4.48	4.6
			80/67	74.8	55.7	88.6	4.18	17.9			70	68.2	51.4	4.89	4.1
			85/71	79.9	57.4	93.8	4.21	19.0			80	68.9	48.7	5.36	3.8
	18	3.0 (6.9)	75/63	71.4	54.9	84.5	3.98	17.9		3.2 (7.3)	60	73.2	57.9	4.54	4.7
			80/67	76.4	56.8	89.7	4.00	19.1			70	72.6	54.0	4.96	4.3
			85/71	81.9	58.1	95.3	4.03	20.3			80	70.3	51.9	5.42	3.8
80	9	0.8 (1.9)	75/63	65.0	52.3	80.3	4.66	13.9	60	0.9 (2.0)	60	75.6	59.6	4.58	4.8
			80/67	69.6	53.7	85.0	4.71	14.8			70	74.5	57.0	5.01	4.4
			85/71	73.9	56.4	89.5	4.75	15.6			80	73.6	54.4	5.49	3.9
	12	1.4 (3.2)	75/63	66.5	52.5	81.3	4.51	14.8		1.5 (3.4)	60	79.3	63.0	4.65	5.0
			80/67	71.2	54.4	86.1	4.54	15.7			70	77.9	60.0	5.08	4.5
			85/71	76.1	56.0	91.2	4.57	16.7			80	76.0	56.7	5.55	4.0
	18	2.9 (6.6)	75/63	67.9	53.4	82.1	4.34	15.7		3.1 (7.1)	60	82.7	66.8	4.73	5.1
			80/67	72.9	55.0	87.3	4.36	16.7			70	78.9	61.3	5.12	4.5
			85/71	77.9	57.2	92.4	4.38	17.8			80	79.4	60.0	5.62	4.1
85	9	0.8 (1.9)	75/63	63.5	51.3	79.4	4.86	13.1	70	0.9 (2.0)	60	84.6	68.0	4.75	5.2
			80/67	67.7	53.4	83.8	4.90	13.8			70	82.6	64.6	5.18	4.7
			85/71	72.2	55.2	88.5	4.95	14.6			80	81.8	61.7	5.67	4.2
	12	1.3 (3.1)	75/63	64.9	51.9	80.3	4.69	13.8		1.4 (3.3)	60	88.5	72.1	4.84	5.4
			80/67	69.4	53.6	85.0	4.73	14.7			70	86.9	69.1	5.27	4.8
			85/71	74.2	55.4	89.9	4.76	15.6			80	85.4	65.1	5.75	4.4
	18	2.8 (6.5)	75/63	66.2	52.7	81.0	4.53	14.6		3.0 (6.9)	60	93.3	76.1	4.93	5.6
			80/67	71.1	54.3	86.0	4.55	15.6			70	91.2	72.3	5.36	5.0
			85/71	75.9	56.4	91.0	4.57	16.6			80	89.3	68.4	5.84	4.5
90	9	0.8 (1.8)	75/63	61.8	50.9	78.3	5.06	12.2	80	0.8 (1.9)	60	93.8	76.6	4.94	5.6
			80/67	65.9	53.1	82.6	5.10	12.9			70	92.1	73.3	5.38	5.0
			85/71	70.4	54.4	87.4	5.16	13.6			80	90.6	69.9	5.87	4.5
	12	1.3 (3.1)	75/63	63.3	51.1	79.3	4.90	12.9		1.4 (3.2)	60	98.4	80.9	5.03	5.7
			80/67	67.3	53.9	83.5	4.92	13.7			70	96.4	77.2	5.47	5.2
			85/71	72.1	55.1	88.4	4.97	14.5			80	94.5	73.9	5.96	4.6
	18	2.8 (6.4)	75/63	64.5	52.0	79.9	4.73	13.6		2.9 (6.6)	60	103.7	85.8	5.14	5.9
			80/67	69.0	53.9	84.7	4.75	14.5			70	101.4	81.8	5.57	5.3
			85/71	74.1	55.3	89.8	4.78	15.5			80	99.1	77.2	6.06	4.8
100	9	0.8 (1.8)	75/63	58.2	50.1	76.2	5.51	10.6	Operation Not Recommended						
			80/67	62.6	51.3	80.8	5.56	11.2							
			85/71	66.6	53.3	85.0	5.61	11.9							
	12	1.3 (3.0)	75/63	59.5	50.5	76.9	5.33	11.2							
			80/67	63.9	52.0	81.5	5.37	11.9							
			85/71	68.2	54.0	85.9	5.41	12.6							
	18	2.7 (6.2)	75/63	61.0	50.6	77.9	5.17	11.8							
			80/67	65.3	52.5	82.4	5.19	12.6							
			85/71	69.9	54.3	87.0	5.21	13.4							
110	9	0.7 (1.7)	75/63	54.9	48.3	74.7	6.05	9.1							
			80/67	58.7	50.1	78.7	6.10	9.6							
			85/71	62.6	52.1	82.7	6.14	10.2							
	12	1.3 (2.9)	75/63	56.0	49.0	75.1	5.86	9.5							
			80/67	60.1	50.6	79.4	5.89	10.2							
			85/71	64.3	52.3	83.7	5.93	10.8							
	18	2.6 (6.1)	75/63	57.4	49.0	75.9	5.68	10.1							
			80/67	61.5	51.1	80.1	5.70	10.8							
			85/71	65.9	52.7	84.7	5.72	11.5							

See Legend and Notes on page 16.

ANTIFREEZE CORRECTION TABLE

ANTIFREEZE TYPE	ANTIFREEZE %	COOLING EWT 90 F			HEATING EWT 30 F		WPD CORRECTION FACTOR
		Total Capacity	Sensible Capacity	kW	Heating Capacity	kW	EWT 30 F
Propylene Glycol	0	1.000	1.000	1.000	1.000	1.000	1.000
	5	0.997	0.997	1.004	0.989	0.997	1.060
	10	0.994	0.994	1.006	0.986	0.995	1.125
	15	0.990	0.990	1.009	0.978	0.988	1.190
	25	0.983	0.983	1.016	0.960	0.979	1.300
	30	0.979	0.979	1.020	0.950	0.974	1.736
	35	0.975	0.974	1.024	0.940	0.969	1.834
Methanol	5	0.997	0.997	1.003	0.990	0.997	1.060
	10	0.996	0.996	1.005	0.979	0.993	1.100
	15	0.994	0.994	1.008	0.970	0.990	1.140
	20	0.992	0.992	1.011	0.961	0.987	1.248
Ethanol	5	0.998	0.998	1.002	0.981	0.994	1.160
	10	0.996	0.996	1.004	0.960	0.988	1.230
	15	0.992	0.992	1.006	0.944	0.983	1.280
	25	0.986	0.986	1.009	0.917	0.974	1.400
Ethylene Glycol	5	0.997	0.997	1.003	0.993	0.998	1.060
	10	0.995	0.995	1.004	0.986	0.996	1.120
	15	0.992	0.992	1.005	0.980	0.993	1.190
	25	0.988	0.988	1.009	0.970	0.990	1.330
	30	0.985	0.985	1.012	0.965	0.987	1.400

LEGEND

EWT — Entering Water Temperature
WPD — Water Pressure Differential

CONSTANT TORQUE ECM MOTOR BLOWER PERFORMANCE DATA

50PTH, PTV UNIT	RATED AIRFLOW (Cfm)	FAN SPEED	FACTORY SETTING	AIRFLOW (Cfm) External Static Pressure (in. wg)											
				0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00	1.10	1.20
024	950	5		1,154	1,117	1,077	1,034	988	938	886	830	—	—	—	—
	825	4	Full Load	1,072	1,018	966	915	866	818	772	727	—	—	—	—
	725	3		976	920	867	815	766	719	674	631	—	—	—	—
	650	2	Part Load/Fan Only	906	844	785	730	678	630	585	544	—	—	—	—
	500	1		829	750	676	610	551	498	451	412	—	—	—	—
036	1300	5		1,506	1,469	1,430	1,390	1,347	1,300	1,249	1,193	1,130	1,061	—	—
	1100	4	Full Load	1,425	1,326	1,250	1,191	1,143	1,100	1,056	1,006	942	860	—	—
	950	3		1,354	1,233	1,138	1,063	1,002	950	901	850	791	719	—	—
	800	2	Part Load/Fan Only	1,294	1,157	1,041	946	866	800	744	696	653	611	—	—
	750	1		1,213	1,084	976	886	812	750	698	653	612	573	—	—
048	1800	5		1,950	1,912	1,880	1,852	1,826	1,800	1,771	1,737	1,695	1,644	—	—
	1600	4	Full Load	1,774	1,738	1,703	1,669	1,635	1,600	1,562	1,521	1,475	1,423	—	—
	1400	3		1,565	1,526	1,493	1,463	1,432	1,400	1,363	1,319	1,265	1,199	—	—
	1300	2	Part Load/Fan Only	1,506	1,469	1,430	1,390	1,347	1,300	1,249	1,193	1,130	1,061	—	—
	1100	1		1,425	1,326	1,250	1,191	1,143	1,100	1,056	1,006	942	860	—	—
060	2200	5		2,476	2,403	2,338	2,283	2,237	2,200	2,172	2,153	2,142	2,141	2,149	2,166
	2000	4	Full Load	2,170	2,135	2,100	2,066	2,033	2,000	1,968	1,937	1,907	1,877	1,848	1,819
	1800	3		1,942	1,914	1,886	1,858	1,829	1,800	1,770	1,741	1,710	1,680	1,649	1,617
	1600	2	Part Load/Fan Only	1,766	1,729	1,693	1,660	1,629	1,600	1,573	1,548	1,526	1,505	1,487	1,470
	1400	1		1,561	1,520	1,483	1,451	1,423	1,400	1,381	1,366	1,356	1,350	1,349	1,352
070	2500	5		2,723	2,671	2,622	2,578	2,537	2,500	2,467	2,437	2,412	2,390	2,372	2,358
	2350	4	Full Load	2,566	2,529	2,489	2,446	2,399	2,350	2,298	2,242	2,184	2,122	2,057	1,990
	2100	3		2,256	2,230	2,202	2,171	2,137	2,100	2,060	2,017	1,971	1,922	1,871	1,816
	1850	2	Part Load/Fan Only	2,004	1,975	1,945	1,915	1,883	1,850	1,816	1,781	1,745	1,708	1,669	1,630
	1600	1		1,766	1,728	1,693	1,660	1,629	1,600	1,573	1,548	1,526	1,505	1,486	1,470

LEGEND

— — Operation Not Recommended

Performance data (cont)

ECM CONSTANT CFM MOTOR BLOWER PERFORMANCE DATA

50PTH, PTV UNIT	RATED AIRFLOW (Cfm)	FAN SPEED	ADJUSTMENT	AIRFLOW (Cfm) External Static Pressure (in. wg)									
				0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00
024 PART LOAD	725	High	+	725	725	725	725	725	725	725	725	—	—
	650	Med	Normal	650	650	650	650	650	650	650	650	—	—
	500	Low	-	500	500	500	500	500	500	500	500	—	—
024 FULL LOAD	950	High	+	950	950	950	950	950	950	950	950	—	—
	825	Med	Normal	825	825	825	825	825	825	825	825	—	—
	725	Low	-	725	725	725	725	725	725	725	725	—	—
036 PART LOAD	950	High	+	950	950	950	950	950	950	950	950	950	950
	800	Med	Normal	800	800	800	800	800	800	800	800	800	800
	750	Low	-	750	750	750	750	750	750	750	750	750	750
036 FULL LOAD	1300	High	+	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300
	1100	Med	Normal	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100
	950	Low	-	950	950	950	950	950	950	950	950	950	950
048 PART LOAD	1400	High	+	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400
	1300	Med	Normal	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300	1,300
	1100	Low	-	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100
048 FULL LOAD	1800	High	+	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800
	1600	Med	Normal	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600
	1400	Low	-	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400
060 PART LOAD	1800	High	+	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800
	1600	Med	Normal	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600
	1400	Low	-	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400
060 FULL LOAD	2200	High	+	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200
	2000	Med	Normal	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
	1800	Low	-	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800
070 PART LOAD	2100	High	+	2,100	2,100	2,100	2,100	2,100	2,100	2,100	2,100	2,100	2,100
	1850	Med	Normal	1,850	1,850	1,850	1,850	1,850	1,850	1,850	1,850	1,850	1,850
	1600	Low	-	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600	1,600
070 FULL LOAD	2500	High	+	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500
	2350	Med	Normal	2,350	2,350	2,350	2,350	2,350	2,350	2,350	2,350	2,350	2,350
	2100	Low	-	2,100	2,100	2,100	2,100	2,100	2,100	2,100	2,100	2,100	2,100

LEGEND

— — Operation Not Recommended

50PTH,PTV SOUND DATA

UNIT SIZE		LOAD	OCTAVE BAND SOUND POWER LEVELS dB, re 10-12 WATTS CENTER FREQUENCY - Hz								A WEIGHTED OVERALL (dBA)	
			63	125	250	500	1000	2000	4000	8000	AHRI-260:2011 (50 Hz-10 kHz)	AHRI-260:2001 (100 Hz-10 kHz)
024	Casing Radiated	Cooling Part	79	66	60	54	53	44	38	31	59	58
		Cooling Full	80	63	60	54	54	47	40	37	59	58
		Heating Part	74	66	59	54	52	43	38	31	58	57
		Heating Full	74	65	61	53	54	45	39	34	58	58
		FAN Only	73	61	56	51	48	43	38	30	54	53
	Ducted Discharge	Cooling Part	75	67	60	67	63	59	56	49	68	63
		Cooling Full	76	68	62	68	65	61	58	52	70	67
		Heating Part	77	67	60	65	63	58	56	49	67	63
		Heating Full	77	70	62	68	65	61	59	53	70	67
		FAN Only	75	67	60	66	63	59	56	49	67	63
036	Casing Radiated	Cooling Part	75	61	53	50	45	39	34	31	53	52
		Cooling Full	75	65	55	52	49	43	41	40	56	55
		Heating Part	74	60	52	50	44	38	33	30	53	52
		Heating Full	73	66	57	51	48	42	39	36	56	55
		FAN Only	66	53	48	45	42	36	29	24	48	47
	Ducted Discharge	Cooling Part	78	65	56	61	59	55	53	46	64	63
		Cooling Full	89	71	59	63	62	59	57	51	68	67
		Heating Part	79	65	56	61	59	56	53	46	64	63
		Heating Full	80	68	59	63	62	59	58	52	67	67
		FAN Only	79	66	56	61	59	55	53	46	64	63
048	Casing Radiated	Cooling Part	75	69	56	52	50	43	36	32	57	57
		Cooling Full	77	75	60	53	53	48	40	36	62	61
		Heating Part	77	69	58	52	51	43	35	31	58	57
		Heating Full	76	75	69	53	53	47	39	34	63	63
		FAN Only	69	56	56	49	48	43	35	27	53	52
	Ducted Discharge	Cooling Part	82	70	59	63	63	59	58	52	67	67
		Cooling Full	88	75	64	67	66	64	62	58	72	71
		Heating Part	81	69	60	64	63	60	58	53	68	67
		Heating Full	83	74	64	67	66	64	63	58	71	71
		FAN Only	86	70	60	63	62	60	58	52	68	67
060	Casing Radiated	Cooling Part	82	66	58	55	51	45	42	37	59	57
		Cooling Full	79	72	62	58	55	49	47	42	62	61
		Heating Part	76	67	62	57	52	47	47	47	60	60
		Heating Full	82	74	63	58	56	49	46	42	63	62
		FAN Only	71	60	57	53	49	44	39	29	55	55
	Ducted Discharge	Cooling Part	89	73	63	67	63	61	60	54	70	69
		Cooling Full	94	79	68	70	68	66	66	61	75	74
		Heating Part	88	74	63	67	64	61	60	54	70	70
		Heating Full	94	79	68	70	68	66	66	61	75	74
		FAN Only	87	73	63	67	64	62	60	54	70	70
070	Casing Radiated	Cooling Part	82	68	61	57	52	49	44	36	61	59
		Cooling Full	80	72	63	59	54	51	46	39	62	61
		Heating Part	75	71	63	59	52	48	44	40	61	61
		Heating Full	77	74	64	60	55	50	45	37	63	63
		FAN Only	73	63	61	55	51	49	44	42	58	58
	Ducted Discharge	Cooling Part	92	78	67	69	68	66	64	59	74	73
		Cooling Full	97	83	72	72	73	70	69	64	78	77
		Heating Part	92	79	68	70	69	66	64	59	74	74
		Heating Full	96	82	73	73	74	70	69	64	79	78
		FAN Only	93	79	68	70	69	66	64	59	74	74

Electrical data

50PTH,PTV BLOWER MOTOR ELECTRICAL DATA

50PT UNIT SIZE	RATED VOLTAGE v-ph-Hz	VOLTAGE MIN/MAX	COMPRESSOR			TOTAL UNIT CONST TORQUE MOTOR (STANDARD)			TOTAL UNIT ECM CONST AIR FLOW MOTOR (OPTION)		
			QTY	RLA	LRA	FLA	MIN CIRCUIT AMPS	MAX FUSE/ HACR	FLA	MIN CIRCUIT AMPS	MAX FUSE/ HACR
50PT024	208/230-1-60	197/253	1	11.7	58.3	2.8	17.4	25	2.8	17.4	25
	265/277-1-60	—	1	9.1	54.0	2.6	14.0	20	2.6	14.0	20
	208/230-3-60	197/253	1	6.5	55.4	2.8	10.9	15	2.8	10.9	15
	460-3-60	—	1	3.5	28.0	2.1	6.4	15	2.6	6.9	15
50PT036	208/230-1-60	197/253	1	15.3	83.0	6.0	25.1	35	6.8	25.9	35
	265/277-1-60	—	1	13.0	72.0	4.9	21.2	30	5.5	21.8	35
	208/230-3-60	197/253	1	11.6	73.0	6.0	20.5	30	6.8	21.3	30
	460-3-60	—	1	5.7	38.0	3.2	10.4	15	5.5	12.6	15
50PT048	208/230-1-60	197/253	1	21.2	104.0	6.0	32.4	50	6.8	33.2	50
	208/230-3-60	197/253	1	14.0	83.1	6.0	23.5	35	6.8	24.3	35
	460-3-60	—	1	6.4	41.0	3.2	11.3	15	5.5	13.5	15
50PT060	208/230-1-60	197/253	1	27.1	152.9	7.6	41.5	60	9.1	43.0	70
	208/230-3-60	197/253	1	16.5	110.0	7.6	28.3	40	9.1	29.8	45
	460-3-60	—	1	7.2	52.0	4.0	13.1	20	6.9	16.0	20
50PT070	208/230-1-60	197/253	1	29.7	179.2	7.6	44.7	70	9.1	46.2	70
	208/230-3-60	197/253	1	17.6	136.0	7.6	29.6	45	9.1	31.1	45
	460-3-60	—	1	8.5	66.1	4.0	14.6	20	6.9	17.5	25

LEGEND

FLA — Full Load Amps
HACR — Heating, Air Conditioning and Refrigeration
LRA — Locked Rotor Amps
MAX — Maximum
MIN — Minimum
RLA — Rated Load Amps

50PTH,PTV UNITS WITH EH OPTION — CONSTANT TORQUE ECM MOTOR ELECTRICAL DATA

50PT UNIT SIZE	EH RATED kW	STAGE	HEATER WATTS		HEATER AMPS		MOTOR FLA (A)	CIRCUIT FUSES	MCA		MOP	
			240	208	240	208			240	208	240	208
024	4.8	1	4,800	3,600	20.0	17.3	2.8	—	28.5	25.1	30	30
036	4.8	1	4,800	3,600	20.0	17.3	6.0	—	32.5	29.1	35	30
	9.6	1	9,600	7,200	40.0	34.6	6.0	—	57.5	50.8	60	60
048	4.8	1	4,800	3,600	20.0	17.3	6.0	—	32.5	29.1	35	30
	9.6	1	9,600	7,200	40.0	34.6	6.0	—	57.5	50.8	60	60
	14.4	2	14,400	10,800	60.0	51.9	6.0	F1/F2 F3/F4	82.5	72.4	90	80
060	4.8	1	4,800	3,600	20.0	17.3	7.6	—	34.5	31.1	35	35
	9.6	1	9,600	7,200	40.0	34.6	7.6	—	59.5	52.8	60	60
	14.4	2	14,400	10,800	60.0	51.9	7.6	F1/F2 F3/F4	84.5	74.4	90	80
	19.2	2	19,200	14,000	80.0	69.2	7.6	F1/F2 F3/F4	109.5	96.0	110	100
070	4.8	1	4,800	3,600	20.0	17.3	7.6	—	34.5	31.1	35	35
	9.6	1	9,600	7,200	40.0	34.6	7.6	—	52.8	52.8	60	60
	14.4	2	14,400	10,800	60.0	51.9	7.6	F1/F2 F3/F4	84.5	74.4	90	80
	19.2	2	19,200	14,000	80.0	69.2	7.6	F1/F2 F3/F4	109.5	96.0	110	100

LEGEND

EH — Electric Heat
FLA — Full Load Amps
MCA — Minimum Circuit Amps
MOP — Maximum Overcurrent Protection

50PTH,PTV UNITS WITH ELECTRIC HEAT OPTION — CONSTANT AIRFLOW ECM MOTOR ELECTRICAL DATA

50PT UNIT SIZE	EH RATED kW	STAGE	HEATER WATTS		HEATER AMPS		MOTOR FLA (A)	CIRCUIT FUSES	MCA		MOP	
			240	208	240	208			240	208	240	208
024	4.8	1	4,800	3,600	20.0	17.3	2.8	—	28.5	25.1	30	30
036	4.8	1	4,800	3,600	20.0	17.3	6.8	—	33.5	30.1	35	35
	9.6	1	9,600	7,200	40.0	34.6	6.8	—	58.5	51.8	60	60
048	4.8	1	4,800	3,600	20.0	17.3	6.8	—	33.5	30.1	35	35
	9.6	1	9,600	7,200	40.0	34.6	6.8	—	58.5	51.8	60	60
	14.4	2	14,400	10,800	60.0	51.9	6.8	F1/F2 F3/F4	83.5	73.4	90	80
060	4.8	1	4,800	3,600	20.0	17.3	9.1	—	36.4	33.0	40	35
	9.6	1	9,600	7,200	40.0	34.6	9.1	—	61.4	54.6	70	60
	14.4	2	14,400	10,800	60.0	51.9	9.1	F1/F2 F3/F4	86.4	76.3	90	80
	19.2	2	19,200	14,000	80.0	69.2	9.1	F1/F2 F3/F4	111.4	97.9	125	100
070	4.8	1	4,800	3,600	20.0	17.3	9.1	—	36.4	33.0	40	35
	9.6	1	9,600	7,200	40.0	34.6	9.1	—	61.4	54.6	70	60
	14.4	2	14,400	10,800	60.0	51.9	9.1	F1/F2 F3/F4	86.4	76.3	90	80
	19.2	2	19,200	14,000	80.0	69.2	9.1	F1/F2 F3/F4	111.4	97.9	125	100

LEGEND

EH — Electric Heat
FLA — Full Load Amps
MCA — Minimum Circuit Amps
MOP — Maximum Overcurrent Protection

Application data

Aquazone™ water source heat pump products are available in a flexible, efficient array of models, which can be used in all types of water loop, ground water, and ground loop systems. Utilize Aquazone products to provide optimal energy efficient solutions and adapt to the most challenging design requirements.

AQUAZONE PRODUCT GUIDE

50 SERIES	TYPE SIZE (tons)	APPLICATION
50HQP,VQP	Large Capacity 6-20 (HQP) 6-30 (VQP)	Environmentally balanced unit with Puron® refrigerant (R-410A) designed to handle large zoned areas for all geothermal and boiler/tower applications.
50PC	Compact $^1/_2$-6	Compact WSHP with Puron refrigerant (R-410A) for boiler/tower, ground water, or ground loop systems.
50PS	Premium Efficiency $^1/_2$-6	Premium, ultra efficient unit with Puron refrigerant (R-410A) for new boiler/tower, ground water, or ground loop systems.
50PEC	High Efficiency Console $^3/_4$-1$^1/_2$	Efficient console unit with Puron refrigerant (R-410A) and attractive design for finished interior, under-window installations.
50PT	Premium Efficiency 2-6	Premium, ultra efficient 2-stage unit with Puron refrigerant (R-410A) for new boiler/ tower, ground water, or ground loop systems.
50PSW	Water-to-Water 3-35	Efficient unit with Puron refrigerant (R-410A) serves as an alternative to pre-heat or cool air. Unit can be used as a stand-alone or supplemental boiler/chiller in most hydronic heating applications. Also conditions process fluids, lubricants, and refrigerants.

Water loop system

Water loop (or boiler/tower) system applications typically include a number of units plumbed to a common piping system. For optimal performance, this system should be designed between 2.25 and 3 gpm per ton of cooling capacity. The system is comprised of highly efficient packaged reverse cycle heat pump units interconnected by a water loop. The water circuit serves as both a sink and source for heat absorption and rejection and is designed for entering water temperatures between 60 F and 90 F. Within this temperature range units can heat or cool as required from the same water source. Transferring heat from warm to cold spaces in the building, whenever they coexist, conserves energy rather than creating new heat.

Refer to the **Carrier Water Source Heat Pump System Design Guide** for assistance with the design of water loop systems. The guide includes a practical approach for the latest and most current design recommendations including:

- product application, including horizontal, vertical, console, rooftop and water-to-water applications
- ventilation methods and system design, including energy recovery
- acoustical considerations for different product types
- addressing indoor air quality (IAQ) issues such as condensate removal and humidity control
- air distribution design including diffuser selection/ layout and ductwork design
- hydronic system design including pipe sizing/layout and boiler/tower sizing
- control configurations such as standalone, DDC (direct digital control), DCV (demand controlled ventilation), and VVT® (variable volume and temperature) controls
- Water Source Heat Pump Efficiency/Operational Cost Comparison chart
- system variations such as a system without a boiler, variable pumping, and variable air volume (VAV) for interior use

Ground water systems

To utilize Aquazone units in ground water applications, extended range should be specified. This will provide factory-installed insulation on the coaxial coil to prevent condensate from dripping when entering water temperatures are below 60 F. In addition, the copper coaxial coil installed on the Aquazone units may not be suitable for all water conditions. Refer to the Water Conditioning section for proper coaxial coil material selection.

Surface water system — This system is typically located near a lake or pond. In this application, the loop can be submerged in a series of coils beneath the water surface. The number of coils required depends on system load and design. This application requires minimum piping and excavation.

Open loop system — This system is used where ground water is plentiful. In this application, ground water is pumped through supply piping from the well to the building. The water is then pumped back into the ground through a discharge well as it leaves the building. An additional heat exchanger is usually installed between the building water piping system and the ground water piping system. This design limits the amount of piping and excavation required.

Aquazone units are provided with a standard TXV (thermostatic expansion valve) and are rated to extremely low temperatures to self-adjust the refrigeration circuit. To conserve water on this type of system, a slow opening/closing solenoid valve is recommended. Depending on loop water temperatures a water regulating valve may be required.

Ground loop systems

There are many commonly specified designs for ground loop applications. Typical designs include vertical loops and horizontal loops. In some applications, water is piped from the ground or lake directly to the water source heat pump. Piping is limited to the amount of pipe required to get the water from the source to the unit.

NOTE: When utilizing Aquazone water source heat pumps in ground loop systems, refer to design considerations in the ground water system section.

Horizontal ground loop — This system is used when adequate space is available and trenching can be easily accomplished. A series of parallel pipes are laid out in trenches 3 to 6 ft below the ground surface, and then back-filled. Often, multiple pipes are used to maximize the heat transfer capability of each trench. The amount of pipe and the size of the ground loop field are based on ground conditions, heating, and cooling requirements of the application and system design.

Vertical ground loop — This system is used in vertical borehole applications. This design is well suited for retrofit applications when space is limited or where landscaping is already complete and minimum disruption of the site is desired. The vertical ground loop system contains a single

loop of pipe inserted into a hole. The hole is back-filled and grouted after the pipe is inserted. The completed loop is concealed below ground. The number of loops required depends on ground conditions, heating and cooling requirements, and the depth of each hole.

Hybrid systems — In some applications, it may be beneficial to incorporate a cooling tower into the ground loop system to reduce the overall cost. A hybrid system discards excess heat into the air and increases the cooling performance of the ground loop.

Condensate drainage

Venting — Condensate lines should be properly vented to prevent fan pressure from causing water to hang up in the piping. Condensate lines should be pitched to assure full drainage of condensate under all load conditions. Chemical treatment should be provided to remove algae in the condensate pans and drains in geographical areas that are conducive to algae growth.

Trapping — Condensate trapping is essential on every water source heat pump unit. A trap is provided to prevent the backflow of moisture from the condensate pan and into the fan intake or downstream into the mechanical system. The water seal or the length of the trap depends on the positive or negative pressure on the drain pan. As a rule of thumb, the water seal should be sized for 1 in. for every 1 in. of negative pressure on the unit. The water seal is the distance from the bottom of the unit condensate piping connection to the bottom of the condensate drain line run-out piping. Therefore, the trap size should be double the water seal dimension.

Horizontal units — Horizontal units should be sloped toward the drain at a $^1/_4$ in. per foot pitch. If it is not possible to meet the pitch requirement, a condensate pump should be designed and installed at the unit to pump condensate to a building drain. Horizontal units are not internally trapped; therefore an external trap is necessary. Each unit must be installed with its own individual trap and means to flush or blow out the condensate drain. The design of a common trap or vent for multiple units is not acceptable. The condensate piping system should not be designed with a pipe size smaller than the drain connection pipe size.

Vertical units — Vertical units utilize a condensate hose inside the cabinet that acts as a trapping loop, therefore an external trap is not necessary. Each unit must be installed with its own vent and means to flush or blow out the condensate drain lines. Do not install a common trap or vent on vertical units.

Water conditioning

In some applications, maintaining proper water quality may require the use of higher corrosion protection for the water-to-refrigerant heat exchanger. Water quality varies from location to location and is unique for each job. Water characteristics such as pH value, alkalinity, hardness, and specific conductance are of importance when considering any WSHP application. Water typically includes impurities and hardness that must be removed. The required treatment will depend on the water quality as well as type of system. Water problems fall into three main categories:

1. Scale formation caused by hard water reduces the heat transfer rate and increases the water pressure drop through the heat exchanger. As water is heated, minerals and salts are precipitated from a solution and deposited on the inside surface of the pipe or tube.
2. Corrosion is caused by absorption of gases from the air coupled with water on exposed metal. Corrosion is also common in salt-water areas.
3. Organic growths such as algae can reduce the heat transfer rate by forming an insulating coating on the inside tube surface. Algae can also promote corrosion by pitting.

NOTE: In most commercial water loop applications, Aquazone WSHP units use copper water-to-refrigerant heat exchanger. Units can and should be equipped with a cupro-nickel heat exchanger for applications where water is outside the standard contaminant limits for a copper heat exchanger.

Application data (cont)

WATER QUALITY GUIDELINES

CONDITION	HX MATERIAL*	CLOSED RECIRCULATING†	OPEN LOOP AND RECIRCULATING WELL**		
Scaling Potential — Primary Measurement					
Above the given limits, scaling is likely to occur. Scaling indexes should be calculated using the limits below.					
pH/Calcium Hardness Method	All	N/A	**pH < 7.5 and Ca Hardness, <100 ppm**		
Index Limits for Probable Scaling Situations (Operation outside these limits is not recommended.)					
Scaling indexes should be calculated at 150 F for direct use and at 90 F for indirect HX use. A monitoring plan should be implemented.					
Ryznar Stability Index	All	N/A	**6.0 - 7.5** If >7.5 minimize steel pipe use.		
Langelier Saturation Index	All	N/A	**–0.5 to +0.5** If <–0.5 minimize steel pipe use. Based upon 150 F direct well, 85 F indirect well HX.		
Iron Fouling					
Iron Fe^{2+} (Ferrous) (Bacterial Iron Potential)	All	N/A	**<0.2 ppm (Ferrous)** If Fe^{2+} (ferrous) >0.2 ppm with pH 6 - 8, O_2<5 ppm check for iron bacteria.		
Iron Fouling	All	N/A	**<0.5 ppm of Oxygen** Above this level deposition will occur.		
Corrosion Prevention††					
pH	All	6 - 8.5 Monitor/treat as needed.	**6 - 8.5** Minimize steel pipe below 7 and no open tanks with pH <8.		
Hydrogen Sulfide (H_2S)	All	N/A	**<0.5 ppm** At H_2S>0.2 ppm, avoid use of copper and cupronickel piping or HXs. Rotten egg smell appears at 0.5 ppm level. Copper alloy (bronze or brass) cast components are okay to <0.5 ppm.		
Ammonia Ion as Hydroxide, Chloride, Nitrate and Sulfate Compounds	All	N/A	**<0.5 ppm**		
Maximum Chloride Levels			Maximum allowable at maximum water temperature.		
			50 F (10 C)	75 F (24 C)	100 F (38 C)
	Copper	N/A	<20 ppm	NR	NR
	Cupronickel	N/A	<150 ppm	NR	NR
	304 SS	N/A	<400 ppm	<250 ppm	<150 ppm
	316 SS	N/A	<1000 ppm	<550 ppm	<375 ppm
	Titanium	N/A	>1000 ppm	>550 ppm	>375 ppm
Erosion and Clogging					
Particulate Size and Erosion	All	<10 ppm of particles and a maximum velocity of 6 fps. Filtered for maximum 800 micron size.	<10 ppm (<1 ppm "sandfree" for reinjection) of particles and a maximum velocity of 6 fps. Filtered for maximum 800 micron size. Any particulate that is not removed can potentially clog components.		
Brackish	All	N/A	Use cupronickel heat exchanger when concentrations of calcium or sodium chloride are greater than 125 ppm are present. (Seawater is approximately 25,000 ppm.)		

LEGEND

HX — Heat Exchanger
N/A — Design Limits Not Applicable Considering Recirculating Potable Water
NR — Application Not Recommended
SS — Stainless Steel

*Heat exchanger materials considered are copper, cupronickel, 304 SS (stainless steel), 316 SS, titanium.

†Closed recirculating system is identified by a closed pressurized piping system.

**Recirculating open wells should observe the open recirculating design considerations.

††If the concentration of these corrosives exceeds the maximum allowable level, then the potential for serious corrosion problems exists.

Sulfides in the water quickly oxidize when exposed to air, requiring that no agitation occur as the sample is taken. Unless tested immediately at the site, the sample will require stabilization with a few drops of one Molar zinc acetate solution, allowing accurate sulfide determination up to 24 hours after sampling. A low pH and high alkalinity cause system problems, even when both values are within ranges shown. The term pH refers to the acidity, basicity, or neutrality of the water supply. Below 7.0, the water is considered to be acidic. Above 7.0, water is considered to be basic. Neutral water registers a pH of 7.0.

To convert ppm to grains per gallon, divide by 17. Hardness in mg/l is equivalent to ppm.

Acoustical design

Sound power levels represent the sound as it is produced by the source, the WSHP unit, with no regard to attenuation between the source and the space. Acoustical design goals are necessary to provide criteria for occupied spaces where people can be comfortable and communicate effectively over the background noise of the air-conditioning system and other background noise sources.

Acoustical design goals are desirable sound pressure levels within a given conditioned space and are represented by noise criteria (NC) curves. Noise criteria curve levels represent a peak over a full spectrum of frequencies. A high value in a low frequency band has the same effect on NC level as a lower value in a high frequency band. It is important that sound levels be balanced over the entire spectrum relative to the NC curve. The lower the NC criteria curve, the more stringent the room acoustical design must be to meet the design goals.

It is important to know how to convert NC levels from the unit ratings in terms of sound power (Lw). This conversion depends on the specifics of the acoustical environment of the installation.

The resulting calculations are compared to the NC curve selected for the area to assess the acoustical design.

Some of the factors that affect conversion of sound power to sound pressure and consequent NC level include:

- type of acoustical ceiling
- use of metal or flex duct
- absorption in the occupied space
- location in the occupied space
- open or closed layout plan
- use of open or ducted returns
- orientation of unit to occupant
- use of lined or unlined duct

WSHP sound control

The analysis of the projected sound level in the conditioned space caused by a WSHP unit located in a ceiling plenum is quite involved. The key is to have good sound power ratings (Lw) in dB on the equipment to determine the sound attenuation effect of the ductwork, ceiling and room. In combination with utilizing standard Aquazone™ equipment attenuating features or the advanced mute package features, suggestions for horizontal and vertical unit sound design are provided to design around the WSHP units.

Horizontal units

Use the following guidelines for layout of Aquazone horizontal units to minimize noise:

1. Obtain sound power ratings in accordance with latest standards from manufacturers to select the quietest equipment.
2. Do not locate units over a space with a required NC of 40 or less. Instead, locate units above less sensitive noise areas such as above or in equipment rooms, utility closets, restrooms, storage rooms, or above corridors.
3. Provide at least 10 feet between WSHP units to avoid the additive effect of two noise sources.
4. Provide an acoustical pad underneath the WSHP unit in applications where the unit must be mounted above noise sensitive areas such as private offices or conference rooms. The pad attenuates radiated noise. Be sure the pad has an area at least twice that of the WSHP footprint.
5. Maximize the installed height above the suspended ceiling.
6. Be sure the WSHP unit is located at least 6 feet away from any ceiling return grille to prevent line-of-sight casing noise from reaching the space below.
7. Suspend the WSHP unit from the ceiling with hangers that utilize spring or neoprene type isolators to reduce vibration transmission.
8. Utilize flexible electrical connections to the WSHP unit. DO NOT USE NOT RIGID CONNECTIONS.
9. Utilize flexible loop water and condensate piping connections to the WSHP unit.
10. Use a canvas duct connector to connect the WSHP discharge to the downstream duct system. This reduces vibration-induced noise.
11. Provide acoustic interior lining for the first 20 feet of discharge duct, or until the first elbow is reached. The elbow prevents line-of-site sound transmission in the discharge duct.
12. Provide turning vanes in ductwork elbows and tees to reduce air turbulence.
13. Size the sheet metal supply duct with velocities no greater than 1000 fpm.
14. Ensure ductwork is rigid.
15. Use round duct whenever possible to further reduce noise.
16. Allow at least 3 equivalent duct diameters of straight duct upstream and downstream of the unit before allowing any fittings, transitions, etc.
17. Seal all penetrations around duct entering the space.
18. Provide a 4-ft run-out duct made of flexible material to connect a diffuser to the supply trunk duct. The flex duct provides an “attenuating end-effect” and reduces duct-transmitted sound before it reaches the space. Typically a 6 dB sound reduction can be accomplished with the use of flex duct.
19. Locate the run-out duct balancing damper as far away from the outlet diffuser as possible. Locating the balancing damper at the trunk duct exit is the best location.
20. If return air is drawn through a ceiling plenum, provide an acoustically lined return duct elbow or “L” shaped boot at the WSHP to eliminate line-of-sight noise into the ceiling cavity and possibly through ceiling return air grilles. Face the elbow or boot away from the nearest adjacent WSHP unit to prevent additive noise.
21. Do not hang suspended ceiling from the ductwork.

Application data (cont)

Vertical units

All guidelines established for horizontal units also apply for vertical units. In addition, since vertical units tend to be installed in small equipment rooms or closets, the following guidelines apply:

1. Mount the unit on a pad made of high-density sound absorbing material such as rubber or cork. Extend the pad beyond the WSHP unit footprint by at least 6 inches in each direction.
2. Since the unit returns airflow through a grille mounted in a closet door, provide a sound barrier or some other modification of the closet to prevent line-of-sight noise into the space.
3. Follow good duct design practice in sizing and locating the connection of the WSHP discharge to the supply duct system. Use an elbow with turning vanes and bent in the direction of the fan rotation to minimize turbulence. Make any duct transitions as smooth and as gradual as possible to minimize turbulence and loss of fan static pressure.

Solenoid valves

In applications using variable flow pumping, solenoid valves can be field-installed and operated from the control board in the Aquazone™ WSHP unit.

Freeze protection

Applications where systems are exposed to outdoor temperatures below freezing (32 F) must be protected from freezing. The most common method of protecting water systems from freezing is adding glycol concentrations into the water. Design care should be used when selecting both the type and concentrations of glycol utilized due to the following:

- Equipment and performance may suffer with high concentrations of glycol and other antifreeze solutions.
- Loss of piping pressure may increase greatly, resulting in higher pumping costs.
- Higher viscosity of the mixture may cause excess corrosion and wear on the entire system.
- Acidity of the water may be greatly increased, promoting corrosion.
- Glycol promotes galvanic corrosion in systems of dissimilar metals. The result is corrosion of one metal by the other, causing leaks.

Hot gas reheat

Hot gas reheat (HGR) allows the user to not only control space temperature, but also humidity levels within the conditioned space. Excessive moisture in the space can promote mold growth leading to damage in the structure or interior surfaces, as well as reducing the air quality and creating an unhealthy environment.

Possible causes of excess humidity could be a byproduct of the unit having to operate under a widely varying load, an oversized short cycling unit, a high percentage of unconditioned outside air being introduced into the space, a high latent load in the space or any location where humidity infiltration is a problem.

Typical unit control is by a wall-mounted thermostat that senses temperature in the occupied space. By utilizing a humidistat in addition to the thermostat, part load units with hot gas reheat are able to control the humidity levels in the space well. The hot gas reheat option allows cooling and dehumidification to satisfy both the thermostat and humidistat while preventing over-cooling of the space while in the dehumidification mode.

Once the thermostat reaches set point temperature, and is above humidity set point, the unit controller will energize the reheat valve operating the unit in hot gas reheat mode, first cooling and dehumidifying, then reheating the air (using hot refrigerant gas) before delivering it to the space, usually 2° to 5° F below room temperature. The unit operates like a dehumidifier by reheating the air along a constant sensible heat line, while the relative humidity of the leaving air is reduced. This option offers significant energy savings over reheating air with electric heating coils.

The moisture removal capacity of a specific heat pump is determined by the unit latent capacity rating. A heat pump's latent capacity can be determined by reviewing the heat pump specification data sheets. Depending upon the entering water and air conditions, a total and sensible capacity can be interpolated from the data sheets. Subtracting sensible capacity from total capacity yields latent capacity. Dividing the latent capacity by 1069 converts the amount of moisture removal from Btuh to lb/hr.

A hot gas reheat valve and a reheat coil are optimal and included in the refrigerant circuit. The refrigerant circuits in the cooling and heating modes are identical to a standard heat pump. In the reheat mode, the compressor discharge gas is diverted through the reheat valve to the reheat coil which is located downstream of the cooling coil. The superheated refrigerant gas reheats the air leaving the cooling coil. The hot refrigerant gas then passes though the water to refrigerant coil where it is condensed to a liquid. From this point the rest of the cooling cycle is completed as in a regular heat pump. There are check valves to prevent refrigerant flow into the reheat coil during standard cooling/heating cycles.

The WSHP Open multi-protocol controller will control mechanical cooling, heating, hot gas reheat and waterside economizer outputs based on its own space temperature input and set points. An optional CO_2 IAQ (indoor air quality) sensor mounted in the space can maximize the occupant comfort. The WSHP Open has its own hardware clock that is automatically set when the heat pump software is downloaded to the board. Occupancy types are described in the scheduling section below. The following sections describe the functionality of the WSHP Open multi-protocol controller. All point objects that are referred to in this sequence of operation will be referenced to the objects as viewed in the BACview6 handheld user interface.

Scheduling

Scheduling is used to start/stop the unit based upon a time period to control the space temperature to specified occupied heating and cooing set points. The controller is defaulted to control by occupied set points all the time, until either a Time Schedule is configured with the Equipment Touch™ interface, i-Vu® Open, or a third party control system Enables/Disables the BAS On/Off point. Your local time and date must be set for these functions to operate properly. The occupancy source can be changed to one of the following:

Occupancy schedules — The controller will be occupied 24/7 until a Time schedule is configured using either, i-Vu Open, Equipment Touch or a third party Enables/Disables the BAS On/Off point. This can be disabled by going to Config>Unit>Occupancy Schedules and changing the point from Enable to Disable.

NOTE: This point must be Enabled in order for i-Vu Open or Bacview6 to assign a Time schedule to the controller.

Schedule_Schedule — The unit will operate according to the schedule configured and stored in the unit. The schedule is accessible via the Equipment Touch user interface, i-Vu Open, or Field Assistant. The daily schedule consists of a start/stop time (standard or 24 hour mode) and seven days of the week, starting with Monday and ending on Sunday.

Occupancy input contact (option) — If configured for remote occupancy control (default), the WSHP Open controller has the capability to use an external dry contact closure to determine the occupancy status of the unit. You will need to disable the Occupancy Schedules in order to utilize the Occupancy Contact Input. The control will cause the unit to go into an occupied mode whenever the abnormal input is sensed. After the input returns to its normal state, the unit will stay in the occupied mode for the configured Occupancy Override Delay period (15 minutes default).

NOTE: Scheduling can only be controlled from one source.

BAS (building automation system) on/off — For use with a Building Automation System that supports network scheduling, you will need to disable the Occupancy Schedules so the BAS system can control the unit through a network communication and the BAS scheduling function.

NOTE: Scheduling can only be controlled from one source.

Global occupancy scheduling — The WSHP Open controller has the capability to read the occupancy status from another unit so that a group of WSHPs can be controlled from a single occupancy schedule. The local Occupancy Schedules must be disabled in order to utilize the global occupancy input.

NOTE: Scheduling can only be controlled from one source.

BACnet network occupancy input — The WSHP Open controller has the capability to accept an external BACnet Binary Network Input for occupancy control. This function is only compatible with units used in BACnet systems. You will need to configure the "System Occupancy" BACnet network input point to locate the device and point name where the external occupancy point information resides. Also Occupancy Schedules must be disabled in order to utilize this input.

NOTE: Scheduling can only be controlled from one source.

Fire/smoke detector (FSD) input (field optional)

The WSHP Open controller has the capability to read the status of a normally closed FSD contact input to determine if a fire or smoke detector alarm is present. If the controller determines an alarm condition is present, all heating, cooling and the fan are disabled. The normal state of the switch is factory set to Normally Closed and cannot be changed.

Shutdown input

The WSHP Open controller has a shutdown input (software) which when set to its Active mode will cause the WSHP to safely shut down in a controlled fashion. Heating and cooling will be disabled after any minimum runtime conditions expire and the fan will be disabled after the fan off timer expires. All alarms are reset but any active alarm will remain active. After the shutdown input transitions from Active mode to Inactive mode, the WSHP Open controller will restart after the configured power fail restart delay expires.

Indoor fan

The indoor fan will operate in any one of three modes depending upon the user configuration selected. Fan mode can be defined/selected as Auto, Continuous, or Always On. In Auto mode the fan is in intermittent operation during both occupied and unoccupied periods. Continuous fan is intermittent during unoccupied periods and continuous during occupied periods. Always On operates the fan continuously during both occupied and unoccupied periods. In the default mode, Continuous, the fan will be turned on whenever any one of the following is true:

- It is in occupied mode. Determined by its occupancy status.
- Whenever there is a demand for cooling or heating in the unoccupied mode.
- When there is a call for dehumidification (optional).

When power is reapplied after a power outage, there will be a configured time delay of 5 to 600 seconds before starting the fan. There are also configured fan delays for Fan On and Fan Off. The fan on delay defines the delay time (0 to 30 seconds; default 10) before the fan begins to

operate after heating or cooling is started while the fan off delay defines the delay time (0 to 180 seconds; default 45) the fan will continue to operate after heating or cooling is stopped. The fan will continue to run as long as the compressors, heating stages, or the dehumidification relays are on. If the SPT failure alarm or condensate overflow alarm is active; the fan will be shut down immediately regardless of occupancy state or demand.

Automatic 3-speed fan control — The WSHP Open controller is capable of controlling up to three fan speeds. The motor will operate at the lowest speed possible to provide quiet and efficient fan operation with the best latent capability. The motor will increase speed if additional cooling or heating is required to obtain the desired space temperature set point. The control increases the motor's speed as the space temperature rises above the cooling or below the heating set point. The amount of space temperature increase above or below the set point required to increase the fan speed is user configurable in the set point. Also, the control will increase the fan speed as the supply-air temperature approaches the configured minimum or maximum limits.

Fan speed control - during heating — Whenever heat is required and active, the control continuously monitors the supply-air temperature to verify it does not rise above the configured Maximum Heating SAT Limit (110 F default). As the SAT approaches this value, the control will increase the fan speed as required to ensure the SAT will remain 5° F below the limit. This feature provides the most quiet and efficient operation by operating the fan at the lowest speed possible.

Fan speed control - during cooling — Whenever mechanical cooling is required and active, the control continuously monitors the supply-air temperature to verify it does not fall below the configured Minimum Cooling SAT Limit (50 F default). As the SAT approaches this value, the control will increase the fan speed as required to ensure the SAT will remain 5° F above the limit. Fan will operate at lowest speed to maximize latent capacity during cooling.

Fan status (option)

An optional input can be configured as either an occupancy input contact or a fan status input. If configured as fan status, the controller will compare the status of the fan to the desired commanded state. Whenever the fan is commanded to run (ON), the fan status will be checked and verified to match the commanded state. If the fan status is not on, then a fan status alarm will be generated after 1 minute and the equipment's compressor(s) and auxiliary heat will be disabled and the optional OA damper will close (if equipped).

Cooling

The WSHP Open controller will operate one or two stages of compression to maintain the desired cooling set point. The compressor outputs are controlled by the PI (proportional-integral) cooling loop and cooling stages capacity algorithm. They will be used to calculate the desired number of stages needed to satisfy the space by comparing the space temperature (SPT) to the appropriate cooling set point. The water side economizer, if applicable, will be used for first stage cooling in addition to the compressor(s).

The following conditions must be true in order for the cooling algorithm to run:

- Cooling is set to Enable
- The Fire/Smoke Input and Shutdown modes are inactive
- Heat mode is not active and the compressor time guard(s) have expired
- Condensate Overflow input is Normal
- Fan Status is true (if option is enabled)
- If occupied, the SPT is greater than the occupied cooling set point
- Space temperature reading is valid
- If unoccupied, the SPT is greater than the unoccupied cooling set point.
- If economizer cooling is available and active and the economizer alone is insufficient to provide enough cooling.
- OAT is greater than the Cooling lockout temperature if OAT is available
- Condenser Water Pump is on (if condenser water linkage active)

If all the above conditions are met, the compressors will be energized as required, otherwise they will be de-energized. If cooling is active and should the SAT approach the minimum SAT limit, the fan will be indexed to the next higher speed. Should this be insufficient and if the SAT falls further (equal to the minimum SAT limit), the fan will be indexed to the maximum speed. If the SAT still continues to fall 5° F below the minimum SAT limit, all cooling stages will be disabled.

During Cooling, the reversing valve output will be held in the cooling position (either B or O type as configured) even after the compressor is stopped. The valve will not switch position until the heating mode is required.

The configuration screens contain the Min SAT parameter as well as cooling lockout based on outdoor air temperature (OAT), both can be adjusted to meet various specifications.

There is a 5-minute off time for the compressor as well as a 5-minute time delay when staging up to allow the SAT to achieve a stable temperature before energizing a second stage of capacity. Likewise, a 45-second delay is used when staging down.

After a compressor is staged off, it may be restarted again after a normal time-guard period of 5 minutes and if the supply-air temperature has increased above the minimum supply air temperature limit.

The WSHP Open controller provides a status input to monitor the compressor operation. The status is monitored to determine if the compressor status matches the commanded state. This input is used to determine if a refrigerant safety switch or other safety device has tripped and caused the compressor to stop operating normally. If this should occur, an alarm will be generated to indicate the faulted compressor condition.

Reverse cycle heating

The WSHP Open controller will operate one or two stages of compression to maintain the desired heating set point. The compressor outputs are controlled by the heating PI

(proportional-integral) loop and heating stages capacity algorithm. They will be used to calculate the desired number of stages needed to satisfy the space by comparing the space temperature (SPT) to the appropriate heating set point. The following conditions must be true in order for the heating algorithm to run:

- Heating is set to Enable
- The Fire/Smoke Input and Shutdown modes are inactive
- Cool mode is not active and the compressor time guard has expired
- Condensate Overflow input is Normal
- Fan Status is true (if option is enabled)
- If occupied, the SPT is less than the occupied heating set point
- Space temperature reading is valid
- If unoccupied, the SPT is less than the unoccupied heating set point
- OAT is less than the Heating lockout temperature if OAT is available.
- Condenser Water Pump is on (if condenser water linkage active)

If all the above conditions are met, the heating outputs will be energized as required, otherwise they will be de-energized. If the heating is active and should the SAT approach the maximum SAT limit, the fan will be indexed to the next higher speed. Should this be insufficient, then if the SAT rises further and reaches the maximum heating SAT limit, the fan will be indexed to the maximum speed. If the SAT still continues to rise 5° F above the maximum limit, all heating stages will be disabled.

During Heating, the reversing valve output will be held in the heating position (either B or O type as configured) even after the compressor is stopped. The valve will not switch position until the cooling mode is required.

The configuration screens contain the Max SAT parameter as well as heating lockout based on outdoor-air temperature (OAT), both can be adjusted to meet various specifications.

There is a 5-minute off time for the compressor as well as a 5-minute time delay when staging up to allow the SAT to achieve a stable temperature before energizing a second stage of capacity. Likewise, a 45-second delay is used when staging down.

After a compressor is staged off, it may be restarted again after a normal time-guard period of 5 minutes and if the supply air temperature has fallen below the maximum supply air temperature limit.

The WSHP Open controller provides a status input to monitor the compressor operation. The status is monitored to determine if the compressor status matches the commanded state. This input is used to determine if a refrigerant safety switch or other safety device has tripped and caused the compressor to stop operating normally. If this should occur, an alarm will be generated to indicate the faulted compressor condition. Also, if auxiliary heat is available (see below), the auxiliary heat will operate to replace the reverse cycle heating and maintain the space temperature as required.

Auxiliary heat

Single-stage electric auxiliary heat — The control can operate a single stage of electric heat installed on the discharge side of the unit in order to maintain the desired heating set point should the compressor capacity be insufficient or a compressor failure occurs. Unless a compressor fault condition exists, the heat stage will only operate to supplement the heat provided by the compressor if the space temperature falls more than one degree below the desired heating set point. The heat stage will be controlled so the SAT will not exceed the Maximum Heating SAT limit and subject to a two-minute minimum OFF time to prevent excessive cycling. Should the compressor(s) fail to operate and heating is required, the auxiliary heat will operate as required to maintain the space temperature set point.

Indoor air quality (IAQ) and demand controlled ventilation (DCV)

If the optional indoor air quality sensor is installed or the network input point "System Space AQ" is utilized, the WSHP Open controller can maintain indoor air quality, with a field-installed modulating OA damper providing demand controlled ventilation. The control operates the modulating OA damper during occupied periods. The control monitors the CO_2 level and compares it to the configured set points and adjusts the ventilation rate as required. The control provides proportional ventilation to meet the requirements of ASHRAE specifications by providing a base ventilation rate and then increasing the rate as the CO_2 level increases. The control will begin to proportionally increase ventilation when the CO_2 level rises above the start ventilation set point and will reach the full ventilation rate when the CO_2 level is at or above the maximum set point. A user configurable minimum damper position ensures that proper base ventilation is delivered when occupants are not present. The IAQ configurations can be accessed through the configuration screen. The following conditions must be true in order for this algorithm to run:

- Damper control is configured for DCV.
- The Fire/Smoke Input and Shutdown modes are inactive.
- Fan Status is true (if option is enabled).
- The unit is in an occupied mode.
- IAQ sensor reading is greater than the DCV Start Control set point.

The control has four user adjustable set points: DCV start control set point, DCV Maximum Control set point, Minimum damper position and the DCV Maximum damper position.

NOTE: In order for the damper to maintain proper base ventilation, the fan must be configured to operate in either the Continuous or Always On mode.

Two-position OA damper — The control can be configured to operate as a ventilation damper in a 2-position ventilation mode to provide the minimum ventilation requirements during occupied periods. This control operation still utilizes the modulating damper actuator.

Dehumidification with hot gas reheat (HGR)

The WSHP Open controller will provide occupied and unoccupied dehumidification only on units that are equipped with the factory-installed HGR option. This function requires an accessory space relative humidity sensor. When using a relative humidity sensor to control dehumidification during occupied or unoccupied times, the dehumidification set points are used accordingly. Additionally, the network input point "System Space RH" may also be used in place of the hard wired RH (relative humidity) sensor. When the indoor relative humidity becomes greater then the dehumidification set point a dehumidification demand will be acknowledged. As long as heating or cooling is not currently active, dehumidification will be energized, bringing on the supply fan (medium speed), mechanical cooling, and the integral refrigerant hot gas reheat coil. The controls will engage cooling mode, start the compressor if not already operating, and waste heat from the compressor cooling cycle will be diverted to the reheat coil. The reversing valve will be positioned to operate the compressor in the cooling mode. If a call for sensible cooling takes place during hot gas reheat operation, the hot gas reheat is de-energized and the reheat operation is turned off. Once the call for cooling has been satisfied and if there is still a need for dehumidification, the unit will continue to operate in a dehumidification mode with the compressor providing cooling and the refrigerant reheat energized.

Demand limit

The WSHP Open controller has the ability to accept three levels of demand limit from the BACnet network. In response to a demand limit, the unit will decrease its heating set point and increase its cooling set point to widen the range in order to immediately lower the electrical demand. The amount of temperature adjustment in response is user adjustable for both heating and cooling and for each demand level. The response to a particular demand level may also be set to zero.

Power failure restart delay

The control provides a user configurable delay when recovering from a power failure or SHUTDOWN mode or when transitioning from unoccupied to occupied mode in order to prevent excessive demand when many units start simultaneously. Each unit can be user configured for a unique delay between 5 and 600 seconds. The factory programmed default delay is 180 seconds.

Fire/smoke detector alarm

The control monitors the voltage input to J1-9 to detect if a smoke detector or fire detector Normally Closed contact has opened, indicating an alarm condition. The control will verify the presence of 24 vac on this input. If the input should open at any time, an alarm will be generated after 3 seconds and the equipment (fan, compressor, auxiliary heat and damper) will immediately return to an OFF or closed state.

Space temperature alarms

The control provides the ability to generate an alarm whenever the space temperature exceeds the alarm set point. A separate occupied hysteresis and fixed unoccupied high and low alarm set points are provided. The control provides a 5-minute alarm delay during unoccupied periods. During occupied periods, the control uses the occupied temperature set points and applies the hysteresis value to determine the alarm set points. Whenever an occupancy transition from unoccupied to occupied occurs or the occupied temperature set points are changed causing an alarm condition to occur, the control will automatically calculate an alarm delay (equivalent to the configured delay time in minutes per degree F times the temperature error that occurred plus 15 minutes). This will prevent nuisance alarms whenever an occupancy change occurs and allows time for the unit to correct an alarming temperature condition.

Condenser water temperature alarm

The control has 4 configurable alarm limits for condenser water temperature. The control will verify that the water temperature is within operating range (between high and low limits) for the specific operating mode (heating or cooling) before energizing the compressor. Once the compressor is started, the condenser water temperature is further monitored to verify that it is within limits to ensure sufficient water is flowing through the coil. Should the leaving water temperature rise above or fall below the appropriate limits, and alarm is generated and the compressor will be shut down if the condition occurs for more than 15 seconds.

Supply air temperature alarm

The control has 2 configurable alarm limits for supply air temperature. The control will verify that the supply air temperature is within operating range (between high and low limits) whenever the compressor or auxiliary heat is operating. Should the air temperature rise above or fall below the appropriate limit, an alarm is generated if the condition occurs for more than 1 minute.

High condensate/overflow alarm

The control will monitor a discrete input to determine the state of a condensate level switch. The input can be configured to alarm on either an open or closed switch condition. Should this input be in an alarm state, the control will start a timer and after the timer exceeds a configurable Condensate Overflow Alarm Delay limit (10-second default), the control will generate an alarm and the unit will disable the compressor and fan outputs.

Fan status alarm (optional)

The control generates a fan status alarm should the fan status input detect the fan is OFF after any fan speed output has been enabled. A 30-second alarm delay is used to allow the fan sufficient time to start operating before an alarm condition is detected. The control monitors the fan output and if the fan is operating at any speed, the fan status must detect the fan is operating.

Compressor status alarm

The control generates a compressor failure alarm should the compressor status input detect the compressor is OFF after the compressor output has been energized. A 6-minute alarm delay is used to allow the compressor to start (prevents alarms due to time guard operation) before an alarm condition is detected. The control monitors the

compressor output and if the compressor output is energized, the compressor status input must detect the compressor operation.

Filter status alarm

The control provides the ability to generate a dirty filter alarm after the number of fan run hours exceeds a configurable filter alarm timer limit. The control monitors the fan output and if the fan is operating at any speed, it accumulates run time. Should the fan run time hours exceed the configurable limit, an alarm is generated. To reset the alarm timer after the alarm has been generated, a Reset Filter Alarm input is provided. The filter alarm can be disabled by setting the Filter Alarm Timer Delay to zero (factory default).

Indoor air quality alarm

The control provides the ability to generate a high CO_2 level alarm during occupied periods whenever the CO_2 sensor value exceeds the user adjustable limit. Whenever an occupancy transition from unoccupied to occupied occurs, or the occupied alarm limit is changed to a value that causes an alarm condition to occur, the control will automatically calculate an alarm delay:

$$\frac{\text{the configured delay time in minutes}}{\text{ppm times the error that occurred}} + 15 \text{ minutes}$$

This prevents nuisance alarms from occurring when occupancy changes or the set point is changed. The IAQ alarm can be disabled by setting Occupied High IAQ Alarm Limit to zero.

Relative humidity alarm

The control provides the ability to generate an alarm whenever the space relative humidity exceeds the alarm set point. Separate occupied and unoccupied high humidity alarm set points are provided. The control provides a 5-minute alarm delay during unoccupied periods. During occupied periods, the controller uses the occupied high RH alarm limit. Whenever an occupancy transition from unoccupied to occupied occurs, or the occupied high alarm limit is lowered causing an alarm condition to occur, the control will automatically calculate an alarm delay:

$$\frac{\text{the configured delay time in minutes}}{\text{\% RH times the humidity error condition that occurred}} + 15 \text{ minutes}$$

This will prevent nuisance alarms whenever an occupancy change occurs and allows time for the unit to correct an alarming humidity condition.

Condenser water linkage failure alarm (if condenser water linkage was active)

The control generates a condenser water linkage failure alarm should linkage fail after once being active. The linkage status is monitored and should it fail to be updated from the Loop Controller, then a Condenser Water Linkage alarm is generated. A 6-minute alarm delay is provided to prevent false alarm from occurring.

NOTE: This alarm can only be reset by re-establishing linkage and correcting the condition that caused the linkage failure to occur or by setting the SHUTDOWN point to Active momentarily.

Airside linkage failure alarm (if airside linkage was active)

The control generates an airside linkage failure alarm should linkage fail after once being active. The linkage status is monitored and should it fail to be updated from the Master Zone Controller, then an Airside Linkage alarm is generated. A 6-minute alarm delay is provided to prevent false alarm from occurring.

NOTE: This alarm can only be reset by re-establishing linkage and correcting the condition that caused the linkage failure to occur or by setting the SHUTDOWN point to Active momentarily.

OAT sensor alarm (if network OA temperature was active)

The control generates an OAT sensor failure alarm should the value of OAT fail to be updated through the Network after once being active. The update status is monitored and should it fail to be updated, then an OAT sensor alarm is generated. An alarm delay (approximately 1 hour) is provided to prevent false alarm from occurring while minimizing the required update rate for OAT.

NOTE: This alarm can be reset by setting the SHUTDOWN point to Active momentarily.

ZS sensor alarm (if ZS sensor was active)

The control generates a ZS sensor failure alarm should the ZS sensor fail to communicate with the control. The update status is monitored and should it fail to be updated, then the alarm is generated.

Guide specifications

Two-Stage Water Source Heat Pumps with Puron® Refrigerant (R-410A)

HVAC Guide Specifications

Size Range: **18,500 to 78,700 Btuh Cooling Capacity**
14,400 to 84,000 Btuh Heating Capacity

Carrier Model Number: **50PTH, 50PTV**

Part 1 — General

1.01 SYSTEM DESCRIPTION

A. Single-package horizontally and vertically mounted water source heat pump with Puron refrigerant (R-410A) and electronic controls.

B. Equipment shall be completely assembled, piped and internally wired. Capacities and characteristics as listed in the schedule and the guide specifications that follow.

1.02 QUALITY ASSURANCE

A. All equipment shall be rated and certified in accordance with ANSI/AHRI/ASHRAE/ISO (American National Standard Institute/Air-Conditioning, Heating and Refrigeration Institute/American Society of Heating, Refrigerating, and Air-Conditioning Engineers/International Organization for Standardization) 13256-1, latest edition, and ETL listed to UL (Underwriters Laboratories) standard 1995. The units shall have AHRI/ISO and ETL labels.

B. All units shall be factory tested in all operating modes and safety switch operation shall be verified. Quality control system shall automatically perform via computer: triple leak check, pressure tests, evacuate and accurately charge system, perform detailed heating and cooling mode tests, and quality cross check all operational and test conditions to pass/fail data base.

NOTE: If unit fails on any cross check, system shall not allow unit to ship.

C. Serial numbers will be recorded by factory and furnished to contractor on report card for ease of unit warranty status. Units shall be prewired and precharged in factory.

Part 2 — Product

2.01 EQUIPMENT

A. General:

Units shall be designed to operate throughout the range of entering fluid temperature of 40 to 120 F in the cooling mode and 20 to 90 F in the heating mode. Equivalent units from other manufacturers can be proposed provided approval to bid is given 10 days prior to bid closing.

B. Basic Construction:

1. Units shall have the airflow arrangement as shown on the plans. If units with these arrangements are not used, the contractor supplying the water source heat pumps is responsible for any extra costs incurred by other trades and must submit detailed mechanical drawings showing ductwork requirements and changes or relocation of any other mechanical or electrical system. If other arrangements make servicing difficult the contractor must provide access panels and clear routes to ease service. The architect must approve all changes 10 days prior to bid.
2. All units shall have stainless steel drain pans to comply with this project's IAQ (indoor air quality) requirements. No exceptions shall be allowed.
3. All water source heat pumps shall be fabricated from heavy gage G-90 galvanized posts and panels. All interior surfaces shall be lined with $^1/_2$ in. thick, 1.5 lb/cu ft dual-density insulation for thermal insulation and acoustic attenuation. Insulation must be non-combustible, non-hydroscopic and anti-fungal. Insulation must meet NFPA (National Fire Protection Association) 90A and 90B for fire protection as well as Fire Hazard classification 25/50 (per ASTM [American Society for Testing and Materials] E84 and UL 723 and CAN/ULC S102-M88), ASTM C1071, erosion requirements of UL181 and be certified to meet GREENGUARD indoor air quality standards for low emitting products. One blower access panel and two compressor compartment access panels shall be removable with supply and return air ductwork in place.
4. Unit shall have a floating basepan consisting of a $^1/_2$ in. thick high density rubber pad between the compressor base plate and the unit basepan to prevent transmission of vibration to the structure.
5. All units shall have a factory-installed four-sided filter rack capable of accepting either one or two-inch filters. Units shall have a 1-in. thick throwaway type fiberglass filter as standard. The filter rack shall incorporate a 1-in. duct flange. The contractor shall purchase one spare set of filters and replace factory-shipped filters upon completion of start-up.
6. Cabinets shall have separate holes and knockouts for entrance of line voltage and low voltage control wiring. Supply and return water connections shall be brass FPT fittings and shall be securely mounted flush to the cabinet allowing for connection to a flexible hose without the use of a back-up wrench. Water connections which protrude through the cabinet shall not be allowed.
7. Hanging brackets shall be provided as standard for horizontal units.
8. All units shall have condensate overflow switch, air-coil and water-coil Freeze sensor as standard.

C. Access Panels:

All units (horizontal and vertical) must have a minimum of three access panels for serviceability of compressor compartment. Units having only one access panel to compressor, heat exchangers, expansion device, or refrigerant piping shall not be acceptable.

D. Unit Removal:

Contractor must ensure that units can be easily removed for servicing and coordinate locations of electrical conduit and lights with the electrical contractor.

E. Compressor:

1. Two-stage hermetic compressor specifically designed for heat pump operation and shall be internally protected with thermal overload protection and mounted on rubber vibration isolators.
2. The compressor shall have a dual level vibration isolation system.
3. Compressor shall be located in an insulated compartment away from airstream to minimize sound transmission.

F. Fan and Motor Assembly:

1. Units shall have a direct-drive centrifugal fan. A constant torque electronically commutated motor shall be used for premium efficiency. These motors shall feature 5 pre-programmed torque settings that can be changed in the field to match design requirements. 460 v, 3 ph, 60 Hz units with these motors must be able to operate without the need for a neutral wire for the motor.
2. The fan motor shall be isolated from the housing by torsionally flexible isolation.
3. The fan and motor assembly must be capable of overcoming the external static pressures as shown on the schedule. External static pressure rating of the unit shall be based on a wet coil. Ratings based on a dry coil shall NOT be acceptable.
4. All units shall have removable blower inlet ring as standard for ease of service and maintenance.
5. Optional pre-programmed high efficiency constant airflow ECM (electronically commutated motor) fan motor.

G. Refrigerant Circuit:

1. Units shall use R-410A refrigerant. All units shall have a factory sealed and fully charged refrigerant circuit with the following components:
2. Bi-directional refrigerant metering thermal expansion valves. Finned tube refrigerant-to-air heat exchanger not exceeding 14 fins per inch. Refrigerant-to-air heat exchangers shall utilize enhanced aluminum fins and rifled copper tube construction rated to withstand 600 psig refrigerant working pressure. All air coils shall have non-ferrous aluminum end plates.
3. Optional coated coils to have copper tubes with tin coating and aluminum fins coated to pass 1000 hour ASTM B117 salt fog testing.
4. Reversing valve. Reversing valves shall be four-way solenoid activated refrigerant valves which shall fail to the heating operation should the solenoid fail to function. Reversing valves which fail to the cooling operation shall not be allowed.
5. Coaxial (tube in tube) refrigerant-to-water heat exchanger. Refrigerant-to-water heat exchangers shall be insulated and with copper inner water tube and steel outer refrigerant tube design rated to withstand 600 psig working refrigerant pressure and 400 psig working water pressure. Shell and tube style refrigerant-to-water heat exchangers shall be treated as pressure vessels and shall require refrigerant pressure relief valves piped to the exterior of the building. The contractor supplying the water source heat pumps with shell and tube heat exchangers shall be responsible for any additional installation costs. Brazed plate water-to-refrigerant heat exchangers shall require additional centrifugal separators added to the supply water piping at each unit. Each separator shall have an automated clean out valve piped to a waste line. The contractor supplying water source heat pumps with brazed plate heat exchangers shall be responsible for any additional costs.
6. Optional cupronickel water coil to have the refrigerant to water heat exchanger made of a cupronickel inner water tube construction.
7. Safety controls including both a high pressure and low pressure switch. Temperature sensors shall not replace these safety switches.
8. Access fittings shall be factory installed on high and low pressure refrigerant lines to facilitate field service.
9. Activation of any safety device shall prevent compressor operation via a lockout circuit. The lockout circuit shall be reset at the thermostat or at the contractor supplied disconnect switch. Units which may be reset at the disconnect switch only shall not be acceptable.

H. Controls and Safeties:

1. Electrical:

A control box shall be located within the unit and shall contain a transformer, controls for the compressor, reversing valve and fan motor operation and shall have a terminal block for low voltage field wiring connections. The transformer shall be rated for a minimum 75 va. All units shall be nameplated for use with time delay fuses or HACR (Heating,

Air-Conditioning, and Refrigeration) circuit breakers. Unit controls shall be 24 volts.

2. Solid-State Safety Circuit:

   All units shall have a solid-state safety control circuit with the following features:

   a. Anti-short cycle time delay on compressor operation.
   b. Random start on power up mode.
   c. Brown out/surge/power interruption protection.
   d. Low pressure switch 120-second bypass timer.
   e. Shutdown on the following fault indications:
      1) High or low refrigerant pressure safety switches inputs.
      2) Freeze sensors shall monitor refrigerant temperature to the water coil in the heating mode and refrigerant coil in the cooling mode.
      3) Condensate sensor input.
   f. Alarm output which closes for selectable dry contact closure or 24 vac remote fault indication.
   g. Alarm output selectable for constant output for general alarm notification, or pulse output for annunciation of the specific fault alarm.
   h. Selectable reset of unit at thermostat or disconnect.
   i. Automatic intelligent reset. Unit shall automatically reset after a safety shutdown and restart after the anti-short cycle timer and random start timer expire. Should a fault reoccur within 60 minutes after reset, then a permanent lockout will occur. Reset attempts shall be selectable for either 2 or 4 tries. A condensate overflow will place the unit in an immediate hard lockout.
   j. Ability to defeat time delays for servicing.
   k. A light-emitting diode (LED) to indicate safety alarms. The LED shall annunciate the following alarms:
      1) High refrigerant pressure,
      2) Low refrigerant pressure,
      3) Low refrigerant temperature to the water coil in the heating operation,
      4) High level of condensate in the drain pan,
      5) Brown out/surge/power interruption.
   l. The LED will display each fault condition as soon as the fault occurs. If a permanent lockout occurs, then the fault LED will display the type of fault until the unit is reset.
   m. UL listed, UL Canada listed, and RFI (radio frequency interference), ESD (electrostatic discharge), and transient protected.
   n. Freeze Protection: A freeze stat shall sense the entering refrigerant temperature to the coaxial coil (in the heating mode) and shall activate the compressor lockout circuit when the refrigerant temperature drops below either 15 F or 30 F. The factory default is 30 F and the temperature setting may be set at 15 F by cutting the resistor (R42) located above the dip switch. The freeze stat may not provide protection in case of loss of flow in the heating mode. A flow switch or pressure differential switch is recommended to prevent unit operation in case of loss of flow. A second freeze sensor shall be mounted at the refrigerant inlet to the air coil. Should the refrigerant temperature drop below 30 F the unit will go into a soft lockout.

3. Deluxe D Controls:

   Optional electronic Deluxe D control shall have all the features of the Complete C control with the following additional features:

   a. 75 va transformer.
   b. Energy Management Switch to enable remote operation of WSHP.
   c. Boilerless system control can switch automatically to electric heat at low loop water temperature.
   d. Phase loss and reversal protection shall be provided on the unit to protect the compressor from operating in reverse rotation.
   e. Auxiliary pump relay to enable a pump operation when calling for compressor operation.

4. WSHP Open Multiple Protocol Controls:

   a. Units shall have all the features above (Complete C Board) and the state of the art WSHP Open multiple protocol interface board. All point objects will have the ability to be viewed in the Equipment Touch™, System Touch™ or field assistant user interface. The following points must be available at a central or remote computer location:
      1) Space temperature
      2) Leaving water temperature
      3) Discharge air temperature
      4) Command of space temperature set point
      5) Cooling status
      6) Heating status
      7) Low temperature sensor alarm
      8) High pressure switch alarm
      9) Fan on/off position of space thermostat
      10) Unoccupied/occupied command
      11) Cooling demand
      12) Heating demand
      13) Fan “ON/AUTO” command
      14) Fault prevention with auto reset
      15) Itemized fault code viewed with Equipment Touch interface

b. Additional WSHP Open multiple protocol control features shall include:
   1) Three-speed fan control. Controller shall automatically, based upon space temperature input, operate the fan at the lowest of 3 selectable speeds to achieve space temperature set point.
   2) Two-position OA (outdoor air) damper
   3) Modulating OA damper with DCV (demand controlled ventilation)
   4) Hot gas reheat solenoid valve
   5) Two-position water economizer control
   6) Modulating water economizer control
   7) Single stage electric auxiliary heat
   8) Power fail restart delay
   9) Two-stage compression control

5. Multiple-protocol WSHP Open controller remote ZS sensors for DDC control options. Only Carrier ZS sensors can be used with the WSHP Open controller. Sensors are available as follows, and all sensors below offer monitoring of space temperature only, or space temperature and CO_2, or space temperature and humidity, or space temperature and CO_2 and humidity.
   a. ZS Standard sensor with a communication port.
   b. ZS Plus sensor with communication port, occupancy status indicator, local occupancy override and setpoint adjustment.
   c. ZS Pro sensor with communication port, occupancy status indicator, local occupancy override, setpoint adjustment, LCD display, alarm indicator and fan speed control.
   d. ZS Pro-F sensor with communication port, occupancy status indicator, local occupancy override, setpoint adjustment, LCD display, alarm indicator, fan speed control, cooling/heating/fan only mode control and F to C conversion.

I. Piping:
1. Supply and return water connections shall be copper FPT fittings and shall be securely mounted flush to the cabinet corner post allowing for connection to a flexible hose without the use of a back-up wrench.
2. All water connections and electrical knockouts must be in the compressor compartment corner post so as to not interfere with the serviceability of unit. Contractor shall be responsible for any extra costs involved in the installation of units that do not have this feature.

J. Factory-Installed Options:
1. Mute package to include compressor blanket.
2. Hot gas reheat to be installed and controlled by a humidistat connected to the H terminal and shall start the unit in the reheat mode should the humidity be above set point once the thermostat control is satisfied. Sensible cooling or heating requirements shall take precedence over hot gas reheat.
3. A non-fused factory-mounted disconnect shall be installed on the unit.
4. A two-way solenoid water valve shall be factory mounted in the interior of the unit. The valve shall cycle open whenever there is a call for compressor operation and the valve shall be equipped with an end switch.
5. An internal secondary pump shall be installed in the unit, 208/230 volts only.
6. Factory-installed UL listed electric heater packages shall be available for the units. Available only on vertical units with top discharge and horizontal units with end blow configuration.
7. Closed cell foam (CCF) shall be installed on interior surfaces of water source heat pump and shall meet the density and compression requirements of ASTM D 1056, the water absorption requirements of ASTM D-1667 and the tensile and elongation requirements of ASTM D-412. Closed cell foam shall meet the flammability requirements of FMVSS302 and UL 94.

K. Accessories:
1. Hose Kits and Valves:

   All units shall be connected to main water supply and return headers with hoses. The hoses shall be 2 ft long, braided stainless steel rated to 400 psig at 265 F. Hoses may contain optional ball valves with P/T (pressure/temperature) ports, Y strainers with blow down valves and/or autoflow regulators as specified in the schedule.
2. Electric Duct Heaters:
   a. Duct heater shall be slip-in type and shall be UL approved for zero clearance to combustible surfaces. The heater shall bear a UL/CSA (Canadian Standards Association) label. Control panel and element housing shall be constructed of heavy gage galvanized steel. All heating elements shall be made of nickel/chromium resistance wire with ends terminated by means of staking and heliarc welding to machine screws. Heating element support structure shall consist of galvanized steel wire formed and constructed to support ceramic bushings through which the heating element passes. Control cabinet shall be constructed of heavy gage galvanized steel with multiple knockouts for field wiring. Control cabinet shall have a solid cover also of heavy gage galvanized steel and held in place with hinges and tool-release latches.
   b. Duct heater shall be supplied with primary over temperature protection by built in disc type automatic reset thermal cutouts and secondary over temperature protection by built in disc type manually resettable thermal

cutouts. These devices must function independently of one another and are not acceptable if series connected in the control circuit wiring. A disconnecting magnetic control circuit is required. All duct heaters will require either a fan interlock circuit or an airflow switch.

c. Over-current protection by means of factory-installed fusing within the control cabinet shall be provided for heaters rated at more than 48 amps. Heating elements shall be subdivided and fused accordingly.

d. All wiring, component sizing, component spacing and protective devices within the control cabinet shall be factory installed and comply with NEC (National Electrical Code) and UL standards. All heaters shall function properly with a 60 Hz power supply.

e. A wiring diagram depicting layout and connections of electrical components within the control cabinet shall be affixed to the inside of the control cabinet cover.

f. A rating plate label shall be affixed to the exterior of the control cabinet cover which states model number, serial number, volts, amps, phase, frequency, control volts, volt-amps and minimum airflow requirements.

Manufacturer reserves the right to discontinue, or change at any time, specifications or designs without notice and without incurring obligations.

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